Reports of the Museum of Natural History
University of Wisconsin-Stevens Point

REPORT 31 – Phenology in Wisconsin

Reports of the Museum of Natural History
University of Wisconsin-Stevens Point

UNIVERSITY OF WISCONSIN-STEVENS POINT
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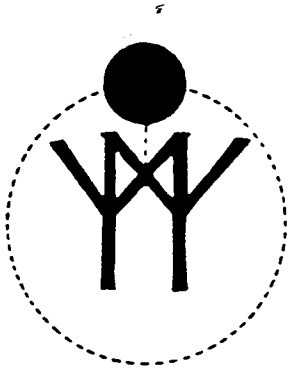

Wisconsin Phenological Society

ANTHOLOGY 1

October 1993

PHENOLOGY IN WISCONSIN

A Collection of Essays, Articles, Data Summaries and Evaluations, originally contributed by friends and members of the Wisconsin Phenological Society and published in WPS Newsletters 1970 to 1990.

Selected and Edited by

Katharina Lettau and Heinz H. Lettau
Madison, Wisconsin
Summer 1993

WISCONSIN PHENOLOGICAL SOCIETY, affiliated with
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Anthology 1 is being mailed to WPS members,
thanks to donations by several friends of phenology.

REPORTS of the
Museum of Natural History,
University of Wisconsin-Stevens Point

NO. 31

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PREFACES

a: Frank D. Bowers, 1992
Director, The Museum of Natural History, UW-SP
Vice-President, Wisconsin Phenological Society

The Museum of Natural History at the University of Wisconsin-Stevens Point is happy to publish this anthology of articles from the Newsletter of The Wisconsin Phenological Society which was formed in 1959. The society was founded on the objective to advance the study of the life cycles of plants and animals and their relationship to the natural seasons. I would like to dedicate this report to three people that have been instrumental in keeping the organization viable and focused on its mission for a quarter of a century: Katharina and Heinz Lettau (Madison, WI) and James Zimmerman (died September 1992).

b: Heinz H. Lettau, Madison, 1993
Increase A. Lapham Professor, Emeritus, UW-Madison
Senior Editor: Phenology in Wisconsin

At the 1991 Annual Meeting, Katharina and I outlined the need for--and the potential benefits of--reprinting selected articles and data reports written by WPL members and published in our Newsletters since 1970. For the 1992 Annual Meeting, I prepared a tentative list of contents of an "Anthology" subtitled "Phenology in Wisconsin." At an executive meeting in October 1992 a final draft version was approved and Frank Bowers accepted the task of having the manuscript re-typed.

I presented the final draft at the Annual Meeting in May 1993 at Stevens Point. It was approved by the members present and accepted by Frank Bowers. Re-typing and proofreading was finished in August. On behalf of WPS I would like to thank Frank and his staff for cooperation.

Let me insert a few words on Katharina's special role in bringing forth this anthology. Since 1966, she took care of routine secretarial duties, and used her previous experience in bioclimatology for editing and producing WPL's annual newsletters over 25 years. She solicited contributions, collected and checked the data reports, and occasionally paid visits to home sites of actively reporting members. She established a basis for statewide data comparison in the form of phenological chronologies. In Chapter 4 of this anthology, chronologies for 10 counties are summarized. Katharina also discussed and exemplified the application of appropriate simple evaluation techniques. Because the decades of the 70's and 80's coincide with her stewardship as WPS secretary, her signature appears under diverse headings in seven of the eight chapters of Anthology 1. Katharina decided to retire last year. I join her in the hope that WPS will find one or two persons who continue the routines of secretarial work combined with collecting and evaluating the phenological data reports.

In 1991 I had estimated that the proposed anthology would have about 75 pages. After approval of the plan I started with a classification of 20 years of newsletter contributions. Soon I found a confirmation of Aldo Leopold who wrote that phenologists are a heterogeneous lot, and phenology is a "horizontal" science which transects all ordinary biological professions (see Chapter 3, Section c1). Moreover, equally important as the perceptions of scientists are the feelings of those who are WPS members simply because of their fascination with watching the seasonality of events in the natural environment.

I attempted to do justice to the great diversity of perceptions, rather than "sifting and winnowing" by any other yardstick. Thus, the final version has 8 chapters and a total of 68 authored contributions on 108 pages. Using somewhat flexible classification methods, I came up with 12 essays, 32 articles, 16 chronologies, and 8 evaluations. The titles of the chapters correspond to the eight major fields of interest. The listing of the authors' location and year of original publication indicate the statewide and out-of-state distribution of friends of phenology, and that their interest prevailed over the years.

The CONSTITUTION of the Wisconsin Phenological Society, Article II, PURPOSES, begins with the statement that the objective of the society shall be the advancement of the study of periodic natural events in plants and animals as influenced by weather . . . .

Anthology 1 provides a look back to WPS activities during the 70's and 80's. There was some advancement but gaps remain. Moreover, new sensing techniques are available and will be used in the 90's and beyond. Let me mention a few examples. Gaps could be filled by a larger number of active observers establishing the basis of chronologies for counties more evenly distributed over the state. Increased attention to phenology of lake flora is desirable. Concerning new techniques, there is the potential of remote sensing by earth satellites. The migration of certain phenological events across the state could be studied with a finer resolution than possible by a network of surface stations. Examples include: In spring, the southwest to northeast "surge of greening" for widespread plant communities, or the areal sequence of opening of the hundreds of Wisconsin lakes. In fall it is the opposite migration of "de-leafing" or closing of lakes. In either case, the special feature of Wisconsin phenology, namely the retarding effects of Lake Superior in the northwest and of Lake Michigan in the east could be investigated in detail.

In conclusion, I believe that our society will continue to flourish and that after another decade, or two decades, there will be generally interesting material for the publication of Anthology 2.

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a: Rewards and Joys

a1. Rewards of being a phenological observer

James Zimmerman, Madison; 1971

It is the awareness of the life around you that the habit of persistent year-round observing and immediate note-taking gradually gives you. You begin to note "unusual" behavior of each plant or animal, things that you had not noticed because you had not even been taking note of the commoner events. You become able to recognize birds even by their lesser known calls and habits. You become able to identify plants when they first begin to grow and after they have shed their seeds as well as when they are in full flower and leaf.

And you begin to appreciate the changes that go on perpetually in the living world – the "rythms spanning the seconds and the years" that Leopold spoke of. This plant got bigger while that one died over five years of observation. Why? Those marsh wrens gradually became more abundant in the 10-acre marsh. Is this part of the population cycle or is it the result of plant succession? The indigo buntings sang later this year than last. Did early nestings fail this season? Possible reasons for these changes present themselves as soon as you are in a position to notice them. It becomes a fascinating game of Sherlock Holmes – you begin to be able to read clues and predict what a wild plant or animal is likely to do.

Here is the real knowledge – not textbook learning – that is the true basis for conservation, the esthetic, ethical and practical; the know-how as well as the heartfelt desire. Phenology, widely studied, could "automate" conservation education.

a2. The making of a Phenologist

Margaret M. Damp, Gillett; 1980

I was a phenologist before I heard the word. Life in a small town was close to the changing seasons and most of the people I knew were phenologists though no one told them. I slipped easily into the field though I never studied botany, nor took a degree in natural sciences. Phenology was in my roots; thousands have similar roots, I believe.

What forces are in a phenologist's background? Before a child is born, give her parents who are aware of the natural world in which they live. Give her a mother who watches changing skies and sees pictures in the cloud formations—a mother who hovers over delicate blossoms, marvelling at their beauty.

Give this child a father who chose to buy a large wooded bluff to save it from lumbermen's greed many years before his child was born. This father and his brother bought a swamp and they refused to have the wetlands destroyed. When the child can walk in the woods, take her out every Sunday afternoon from early spring through late fall. Talk to her about the trees and the flowers—teach her to identify footprints of small animals left beside a river. Show her stars of a winter night—stand beside her watching Northern Lights flame—subside.

Take her trout fishing and teach her about quiet pools, a riffle of water—the quietness. Show her denuded banks along the streams and explain how they happened. Draw her attention to a storm's approach and passing—the rainbow of promise.

The years pass. This child will, in turn, teach her children what she knows of phenology though the word was never mentioned. There will be games of bird identification and of butterflies in splendid hues. Tiny wood violets, mosses, lichens, shelf fungi—all become familiar to her children.

As the earth turns, one day this child is a grandmother. She will stand at a western window with a grandchild to watch Mr. Sun going to bed. The next morning, he sees Mr. Sun rising above the horizon from a window at the east. She will carry a grandchild outdoors to see a sickle moon—the first evening stars. One day this lad will search the heavens with his own telescope.

Another boy stands motionless beside a blue lake, absorbing its wonder. He dreams of "the place where the green grasses sway in the water" and he longs for "some land of my own."

Down in the fourth generation and beyond, phenology is more than a word. it is a way of life.

b. Living With the Seasons

b1. . . . and "subtly" it's spring

Rosemary Fleming, Madison; 1974

Nature's greatest production "SPRING" – like a giant symphony, complete with orchestrations, changing sets, chorus, and guest performers – is fast approaching the staging area. Are you tuned in?

Local cardinals, chickadees, and starlings are proclaiming the events with intermittent songs and whistles. Woodland percussion artists, the woodpeckers and ruffed grouse are drumming. Great horned owls are established on nests in the upper balcony. Prairie chickens are booming. Goldfinches are gradually changing from olive drab to their brighter yellow costumes. Squirrel scurrying, tail-flicking, and chatter announce active courtship time. Wildly honking-skeins of geese write advance notice in the sky!

It's time to check last year's program for the order of events. No two years are exactly the same. Variations occur, but some of the acts are predictable. Patterns of sequence occur in the setting and orchestration. Occasionally a snowy intermission can "stop the music" and "freeze the setting" – causing many dramatic modifications of theme.

Each ecological community – marsh, pond, prairie, forest, field, and backyard – has its own special accents – with diverse sets, chorus, and primadonnas.

Male redwing blackbirds return to the marshes to select their favorite perches in the cattails. Skunk cabbage and alder come into pollen. Chorus frogs tune up. Frost leaves the ground and woodcocks arrive to add evening entertainment with their courtship flights. Silver maple flowers, and the fat marsh marigold buds begin to open. Geese, whistling swans, ducks, and grebe settle into open waters. Pussy willow and boxelder bloom. Fox sparrows, heron, and kingfishers appear.

From the prairie, song sparrows and meadow larks accent the bluebird's bubbly song. Pasque flowers open, and honeybees gather pollen. Draba, lyre-leaved rockcress, and prairie buttercups add color to the set. Anthills are active, and flickers move onto them feeding industriously. Ground squirrels and woodchucks emerge from their winter burrows. Pussytoes add a velvety touch. Field sparrows and tree swallows return.

Along the forest edge where hazelbush and aspen are in bloom, the rabbit scratches out her brood bed. Hepatica adds colorful patches of purple, pink, and white to to the leafy forest floor. Garter snakes ease out of hibernation and sun themselves in warm niches. Tufted titmice, chickadees, nuthatches, golden-crowned kinglets, and local woodpeckers demonstrate great activity as they sing and flit from tree to shrub. Fresh sapsucker drillings in the maples attract flies, tortoise shell, anglewing, and mourning cloak butterflies. High in the aspens new arrival meows his welcome presence. Chipmunks dart along fallen logs. As the bloodroot, dutchman's breeches, and toothwort bloom – fern fiddleheads begin to unfurl, and the white-throated sparrows, towhees, and hermit thrush announce their occupancy of the forest floor.

Snowdrops, scilla, and crocus peek through neighborhood lawns where robins are actively feeding on worms. Silver and red maples flower, followed by white birch. Forsythia, magnolia, and Nanking cherry blossom.

All these observations were noted before April 18 last year. . . . just the overtures to the tumultuous crescendos of later movements and the grand finale of May and early June. Every day, new discoveries await the phenologist's recording. Each year's observations add dimensions to the anticipation, pleasure, and understanding of the response of all living things to the quickening pulse of SPRING.

TUNE IN! RECORD!

If you wait til "spring is bustin' out all over," you have missed half of the performance!

b2. The promise of spring
Jill Dean, Madison; 1979

Jill Dean graciously agreed to look at the letters returned by our members in response to my question. Jill's delightful summary of personal feelings about spring in Wisconsin follows. K.L.

In last spring's newsletter, Katharina Lettau posed an intriguing question: When does spring really begin? "To me," she wrote, "the surest sign that winter has come to an end is when the snowdrops in my front yard have come into bloom." Then she invited members and friends to share their opinions about the indicators of spring's onset, and many did.

Mrs. Robert Rasmussen, of rural Scandinavia, wrote, "In maple country, the first sign of spring is the sap icicles on the broken branches of the sugar maples. The first audible sign is the conk-a-ree of the male red-winged blackbird, who arrives at the swamp to stake a claim on a nesting area for his mate, who arrives later." In perfect agreement was Dennis Crowe, who said, "I consider the arrival of the red-winged blackbirds as opening day." He added, "We are always anxious for the first run of sap, but that signals the end of winter more than the beginning of spring."

Up in Lincoln County, Marie Eaton underscored this distinction. "Today, March 20," she wrote, "they started tapping trees in the local sugar bush. The temperature is in the low thirties, and there's about six inches of snow cover in the woods." But she had noted spring's arrival even earlier, as she reported. "The willows, dogwood, and alder turn color sometime in February, and then we know we are over the hump."

This opinion was seconded by Eva Brown, from Fredonia, who observed, "As winter recedes, the yellow twigs and branches of willows seem to become luminous. There can be lots of snow on the ground yet, but the willow indicates spring is definitely on the way."

Another adherent of the twig theory is Kathleen Ela, of Rochester. "To my mind," she wrote, "color change in apple branches is the first sign of spring. It take place in February, about the time icicles are lengthening and snowdrops appear. It's a subtle change, but always seems to have happened overnight. Branches change from winter gray to rosy red. We do not have willows within view, but after I notice the apple-branch change, I look for willows yellowing and find that happening too."

I dislike winter so intensely that I generally go into shock in November and don't fully recover until May. Thus, I miss many of the truly early signs of spring. Inspired by these reports of snowdrops, twigs, maple sap, and blackbirds, however, I reviewed my own phenological calendars to see what my first entries were from year to year. The calendar confirmed the awful truth. In ten years, there wasn't a single entry in February. There were only a handful in March, but they indicated what signals spring in the Dean household: Jeff charges his motorcycle battery in anticipation of the riding season ahead.

b3. Autumn thoughts

Sandy Sue Szanderek, Milwaukee; 1986

The days pass, becoming shorter and cooler. Autumn, the time of quiet birds and color-splashed landscapes, is again the mood of the land. Hopefully we can all look back on our own springtime promises and smile at a few accomplishments of this "growing season" just as our mother, the earth, is doing. The earth is celebrating now, in the language she herself invented—color, form, and movement—an unabashed extravaganza—a grand finale for the growing season.

It began with a seed nestled on the forest floor, and a tiny bud on a twig in pale spring grayness waiting for green. And now it comes full circle again to a seed and a bud, not in grayness but in brilliant splendor.

In recording the "phenological events" of autumn (or that of any season), we are not only gathering information but we are recording and learning the language of the earth—and hopefully celebrating in our hearts the events we record.

Just as human language symbolizes our thoughts and dreams, phenological events are the symbolic language of the earth: the flowers that stun us with beauty and then vanish, the seasonal restlessness of birds, the thundering power of flood-rains are all expressions of the many moods and facets of the earth. In recording these events we get to know the earth; and in knowing the earth we get to know ourselves, for we are still her children.

I would hope that each of you, as a member of this Society, continues to keep records; and perhaps you would consider a more expanded journal through which earth patterns emerge as a private revelation. Also, please take time this autumn to point out an earth event to a friend or neighbor. And, if you can muster the nerve, consider sharing an event with your local newspaper or radio. Sometimes one succeeds—sometimes not.

For example, a Chippewa woman living in Milwaukee recently tried to share her observation of a huge cloud of dragonflies (8/18/86). A local TV station could not become interested, but the *Milwaukee Journal* made belated mention of it and also gave photo coverage to other such events as the pre-migration flocking of swallows (shown on wires) and nighthawks. As a result, I'm sure a few folks looked up for a change and checked the skies in anticipation. The media need to be encouraged to cover such "simple happenings" because these are the very stuff of the earth's language—a language that is not ours to keep secret but instead to interpret, teach, and celebrate.

b4. Autumn notes from the Wisconsin River Bank
Jean Clausen, Mazomanie; 1979

Along with September's cool, brisk sunny weather comes a subtle change in the colors on our meadow. No longer do the grasses, hoary alyssum, and flowering spurge predominate. Clouds of pink-purple prairie grasses have settled in here and there, to lend a touch of warmth on a crisp morning.

Surely we'll have more of that summertime heat and those colors may not seem so welcome then. Did you ever notice how cleverly our seasons are planned? Lots of green for hot summer days, brilliant oranges and reds for cool fall weather.

A walk through the meadow reveals still another bright color this week. It is a stalk of vivid lavender or pale purple blossoms (if lavender can be called vivid!). Blazing star is the imaginative name given to this flower. Another member of the family – their botanical name is liatrus – is called gayfeather. This is even more descriptive; it looks as though it might have decorated fancy hats in a former era of fashion. Each tiny five pointed star in the densely packed flower heads has two dainty stamens half an inch long, giving the whole plant a whimsical appearance. The members of the liatrus group begin blooming from the top of the spike. The lowest buds are now a tight green. They become raspberry red as they appear to be climbing upward, finally bursting into bloom at the top.

Blazing star is one of the colorful forbs that does well in a dry mesic prairie, so we hoped it would prosper on our river bank. Last year there were many patches of it, just over the fence in the old dead oak woods; but this year I found only four plants, widely scattered. Around them are growing up hundreds of scrub oak trees, now three or four feet high. It seems nature is bound to have an oak forest there, and my prairie can't compete.

The following week many more blazing stars have begun to bloom. Along with patches of goldenrod and yellow sunflowers, they herald the coming brilliance of autumn.

Liatrus not "liatrus"

b5. Winter Reflections—In praise of moderation

Sandy Sue Szandarek, Milwaukee; 1987

Each winter seems to unfold a personality all its own. I remember the winter of 78-79 as a semi-constant snowstorm leaving 6-foot drifts of snow to be painfully relocated. It was a time of cabin fever, sore backs, and survival. The winter of 81-82 is memorable for redefining Milwaukee's notion of cold. Temperatures of 25 below and wind chills of minus 90 broke existing records. The winter of 82-83 danced at the other end of the spectrum. Sixty-two degree weather greeted us that Christmas season. We wore shirt sleeves and a few of us golfed or barbecued burgers. And last year can perhaps best be characterized as the winter of endless ice—harsh and treacherous. A now healed bone in my leg testifies to that!

But this winter—ah, this winter—gave us only carefully measured portions of those elements. Snow came, but late in the season, and even then just enough to address with a shovel—no paralyzing, raging blizzards. Winter '86 brought a few cold snaps but claimed no broken records. For the most part we enjoyed the 20s and 30s, occasionally climbing into the 40s, but never neared the excesses of '82's bitter cold or '83's heat wave. No, winter 86/87 has lived the life of moderation—allowing possums to remain active throughout January, and us to smile gratefully at lower heating bills and to dart about unfettered by extra layers of clothing. Yes, it was a "real" winter but one that carried spring within its heart even in darkest December. I hope you also have enjoyed its gentleness.

c: Responses from Outside People

c1. To Sinclair's: To everything there is a season

Katharina Lettau, Madison; 1984

"TO EVERYTHING THERE IS A SEASON" is the title of Tom Sinclair's article that was published in the spring 1983 issue of "Wisconsin Trails." It had a remarkable impact; quite a few readers of the magazine were inspired to write to our society that they, too, had taken a "cue from nature" when with the waning of winter they began to feel that spring is in the air. They were mentally recording phenological events yet had not known that there exists an organization in Wisconsin interested in documenting such observations. To let our members share these reactions, here are some excerpts from the letters:

"For years I have been watching for the signs of the seasons and did not realize that what I was doing had a name. Told everyone this was to be a mild winter, contrary to all computer reports, because my herd of llamas started to give me wool in December instead of the usual February-March. . . ."

"I have kept these records now for seven years. It's surprising how nature in all its aspects is generally right on schedule. Timing is so certain, that we now plan many of our activities from information found in my log. This includes the best time to have friends and relatives visit, depending on their interests. . . ."

"I am interested in obtaining phenological information. Please respond quickly for the momentum of spring is upon us. . . ."

"Please send me all the information, spring is near, soon the waterfowl and birds will arrive, already the chipmunk is stealing the birdseed on my patio. . . ."

"I have always made mental observations and notes of the signs of spring, but never thought of keeping records. . . ."

One person wrote from California: "I didn't know there was a name for what I require from my high school advanced biology students until I read the article. I was delighted with my discovery. So . . . even in California there are tiny pockets where Wisconsin 'things' are appreciated."

c2. A surge in seasonal interest – A case of sping-fever

Katharine Lettau, Madison; 1991

Phenology describes and explains the development of plants and animals due to seasonal changes, but the interest in phenology is also subject to sesonal changes. The main peak occurs in spring, and a secondary peak in fall when the leaves begin to change color in the northern states. Each year, the spring peak brings forth a number of newspaper articles about phenology stimulating people to apply for membership in our society. The spring peak of 1990 was different insofar as one article published on March 31, 1990, in the *New York Times*, produced some enormous and very widespread interest.

At that time, I was in South Carolina admiring the peak bloom, of azaleas and dogwoods. On my return, I was surprised and overwhelmed by the unusually large number of letters addressed to our society. All of the correspondents referred to an article by Joan Lee Faust in the "Gardening Section" of the *New York Times*. Ms. Faust is not a member of the Wisconsin organization. Her article included not only the address but also the modest annual dues which entitle members to information and copies of previous and future newsletters.

The first batch of 72 letters came mostly from people living in New York, New Jersey, Rhode Island, Connecticut, and other New England states. As of now, the total has reached 144, some from states as far away as New Mexico, California, Colorado and Washington.

Ms. Faust's article dealt mainly with hints for gardeners, such as the scheduling of planting and pruning, stating that phenology serves as the gardener's timepiece. Recent mail indicates that Ms. Faust's article has been reprinted in local newspapers.

It is regrettable that the purpose and goals of the Wisconsin Phenological Society were not clearly stated, namely to collect data of phenological events from the Midwest, particularly within our own state, that are useful for scientific studies. The society was founded for and by the people of Wisconsin. All work is done by volunteers. We operate on a shoestring budget. To add a disproportionately large number of new members from distant states, and to supply them with reporting forms designed for regional use exceeds the means of the Wisconsin organization. However, all applicants did receive the packet of information and blank reporting forms usually mailed to new members.

It should be emphasized that interest in phenology is appreciated and welcomed, but instead of joining the Wisconsin group, regional organizations should be founded in other states for the purpose of recording and reporting phenological events.

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a: The Wisconsin Society's First 25 years: A Retrospective

a1. The period from 1959 to 1972

Tom Sinclair,* Madison; 1984

Who can say why it happened in 1959?

That's when a group of Wisconsin scientists began discussing how to interest more people in phenology. It was a reasonable thing for them to do.

But why 1959?

Was nature study simply at the point where learning more about the annual timing of biological events was the next logical step? Or was it something altogether different, something mystical – the alignment of the stars, perhaps – that drew them together that year? Why things happen when they do is often a mystery. Sometimes it doesn't really matter. What matters is that they happen at all. Nobody knows that better than phenologists.

"I wonder why our lilacs always bloom around May 1 5," a phenological observer might tell you. "but I'm happy just to watch them bloom. For me, that's the best part of spring."

Suffice it to say, then, that for one reason or another it was 1959 when those Wisconsin scientists acted on what they considered a need to determine more clearly how the life cycles of plants and animals in the wild intertwine with the seasons. They decided to enlist the help of other scientists and lay people throughout the state, and their discussions eventually gave birth to the Wisconin Phenological Society, the first such statewide organization in the United States. Because they acted when they did, the Society is now a quarter of a century old.

The Society's history is worth telling at this point. It began with a gratifying call for members that inspired 650 people to join. The Society wasted no time mailing them phenological data report sheets on which to record such events as springtime blossoming of crocus flowers in their locales.

The Holland Bulb Growers Association provided the Society with 4000 crocus bulbs to distribute to the new members so they could report on the growth and flowering of genetically identical plants in different places.

In 1960, at the suggestion of Malcolm N. Dana, Professor of Horticulture at the University of Wisconsin, phenological observers turned their attention to common lilac bushes, watching for the first blooming date. A decade later, they started recording the lilac's first leaf, first flower, peak bloom, and end of bloom. Lilac phases are the Society's most thoroughly recorded events.

Officially, the Wisconsin Phenological Society came into being January 21, 1961, when its first annual meeting took place as part of "Farm and Home Week" at the University of Wisconsin-Madison. Enthusiastic members, 65 in all, adopted a constitution and bylaws that day and elected the first slate of officers: President- Reid A. Bryson, Professor of Meteorology, University of Wisconsin; Vice-president- Donald R. Thompson, Statistician, Wisconsin Conservation Department; Secretary- Philip W. Smith, Entomologist, Plant Industry Division, Wisconsin Department of Agriculture; Treasurer- Ernest L. Chambers, Head, Plant Industry Division, Wisconsin Department of Agriculture.

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Dr. Albert Baumgartner of Munich, Germany, Professor of Forestry, who helped in getting the organization on its feet while a Visiting Scholar at the Madison Department of Meteorology, was elected its first honorary member. In 1962, honorary membership was bestowed on James Dickson, professor of Plant Pathology at the University of Wisconsin at Madison.

It was a good beginning. But keeping the Society together through its earliest years was a struggle. It had no office, no staff, and the annual $1 dues from contributing members netted barely enough for stationery, stamps, data report sheets, and other basic expenses. Calls for additional donations helped, but the Society continued to operate on a shoestring.

The picture brightened in 1964, when the Society held its annual meeting in Wausau, in conjunction with that of the long-established Wisconsin Academy of Sciences, Arts, and Letters. The Society's first meeting outside of Madison drew people from many corners of the state and even a contingent from Houghton, Michigan. The interests of the Wisconsin Phenological Society dovetailed nicely with those of the Wisconsin Academy, and the Society affiliated with Academy in 1965. Malcolm Dana, then president of the Society, remarked that the Board of Directors hoped to benefit from the "common bond of scientific interest held by both organizations." The happy marriage continued today.

By the mid-1960s, Society members had begun a lake-ice study, keeping track of the closing and opening dates of Wisconsin lakes and, when possible, annual ice thickness and snow cover. The list of springtime biological events they watched was growing, too. Their data report sheets had been revised – something that happened many times as the years passed – to make room for new observations or simply to make them easier to use. Finances, though still quite modest, had stabilized.

The Society put its purpose and activities in print with a new brochure in 1967 and published a two-page set of guidelines for phenological observation in 1968 to help make reports from its members more consistent.

Membership held steady at more than 500; of this total, 50-60 people reported faithfully some phenological events annually. Evidently, the majority who joined were just interested in learning about phenology by sharing reports and newsletters. The Society welcomes anyone interested in the seasonal changes in plant and animal life, whether he, or she, participates in the observational program or contributes by paying the $2.00 annual dues.

The Associated Press called attention to the Society in 1968 with a story that it was interested in finding out when people in Wisconsin suffered their first mosquito bites that year, a legitimate though somewhat less than appealing phenological event. Reports came back from as widely scattered locales as Kewaunee, Marinette, and La Crosse that April 12 was the fateful day. Forest and Trempealeau County observers said they were spared the experience until several days later. Still others escaped the insects' spring offensive well into May and June.

John Saeman noted in the Society's newsletter more than a decade later that the first mosquito bite was among the most important annual events to him. Wrote Saeman: "I have always worked in the woods, hence this interest. That first date can be really important if one forgets to stock up on repellent ahead of time. . . . Generally, they (mosquitos) start about May 21 . . . . When the date comes, I am prepared."

As the 1970s began, the Wisconsin Phenological Society was trying to stem confusion over the precise stages in the life cycles of lilacs, scillas, and other plants and animals its observers were supposed to look for. A group of members convened in Madison on a stormy winter day in February 1970 to set down more detailed guidelines and revise, again, the report forms. Remarked then President Dorothy Custer later: "One would think that we – of all the world – would consult the weather charts to pick a meeting date." She added, though, that the weather moderated in the evening and the meeting was well attended.

The Society's general data report listed nearly 80 phenological events that spring, from the first appearance of earthworm castings in March (indicating a thaw in the long-frozen ground) to the initial flash of fireflies in June. There also were spaces for "write-in" summer and fall events.

The Society organized a Phenology Day, the first of two, on the weekend of May 15 and 16 in 1971. On that day, members throughout the state noted phenological happenings in their neighborhood and generally described the "state of nature" at the time. More than 30 people returned survey sheets from more than 20 Wisconsin counties and northern Michigan. Their report showed plenty of variety, even in the weather. An Oneida County observer reported brisk winds and temperatures in the 50s, while a Lafayette County enthusiast found the landscape dry and dusty and basked in 80-plus degrees.

Being a phenologist is a pleasure for those who are so inclined. But it also is work, and it takes dedication to stick with phenological reporting over the years. The Wisconsin Phenological Society has its share of dedicated reporters. By 1972, nearly 40 members had submitted data sheets for 10 consecutive years. They were scattered throughout Wisconsin, from Hammond to Hartland and Peshtigo to Plover.

Nor was their work ignored. Despite its lack of paid staff, the Society found within its ranks members willing to take time to analyze some of the incoming data and describe their findings, both in publications of the Wisconsin Academy and the Society's own newsletter. In addition, scientists at the University of Wisconsin-Madison produced computer maps of the calling dates of the western chorus frog and flowering dates of red maples across Wisconsin in the early 1970s based on the Society's records.

a2. From 1972 to 1984

Tom Sinclair, Madison; 1984

The period from 1972 to 1984 saw further change and experimentation within the organization. About 50 people attended a 1972 Phenology Conference aimed at boosting participation in the Society. The annual meeting shifted from spring to fall, and later to winter. There were more revisions in the spring data sheets and new late summer and fall sheets.

Occasionally a thoughtful member would cast phenology in a new light. One unnamed writer did just that in the Society's spring 1975 newsletter. Said he/she:

"It appears we have given little consideration to the worth of humans as organisms for phenological studies. The connection between human activity and climatic conditions is very real. When, for instance, do you start expecting your seed catalogs or, the Phenological Society newsletter? Who tells you to take off your snow tires or change the storm windows on your house?"

The same writer noted with obvious amusement that UW-Madison Botany Professor Grant Cottam annually sponsored a unique phenological contest whose winner had to predict the first day on which a "bevy of five beauties" would appear sunbathing on top of Chadbourne Hall, a dormitory next to the Botany Department.

"Now, this contest had all the markings of a good phenological observation," noted the writer. "It was an event that was observed daily, it had to be verified by a second observer, and there had to be at least five sunbathers so the event did not record the erratic 'first flower.' After the contest was run a couple of years, the pattern became very apparent. The phenological event generally occurred on the first Tuesday after the end of spring vacation – barring locally inclement weather. . . . Incidentally, the prize was a cheesecake baked by Professor Cottam."

Society President Wayne Pauly, a naturalist, kindled interest in phenological folklore in the latter 1970s through the Society's meetings and newsletters. Among the bits of folk wisdom he uncovered:

If the oak is out before the ash,
'Twill be a summer of wet and splash;
If the ash is out before the oak,
'Twill be a summer of fire and smoke.

On hearing this sort of thing, other members recalled ditties from their past. This was one:

A swarm of bees in May is worth a load of hay.
A swarm of bees in June is worth a silver spoon.
A swarm of bees in July isn't worth a fly.

The Society published a 20-page *Manual for Phenological Observers* in 1977. The attractive booklet contained definitions, illustrations, a bibliography of phenological literature, and additional information on how to observe and what phenological observations might be used for. It was the Society's most ambitious product to date.

But the organization was having new problems. Too few volunteers stepped forward to run its day-to-day business. Some officers agreed to serve beyond their elected terms in the absence of willing replacements. But even more disturbing were meager turnouts at the 1978 and 1979 annual meetings, the latter had been moved back to a spring date, that raised questions about the Society's viability.

Still, actual membership held steady at between 350 and 400 after the first major culling of the mailing list in 1975-76. And the Society had a core group of loyal members determined to carry the organization through the doldrums.

It is risky to single out people in an organization for outstanding service because others who deserve much credit may go unmentioned. Yet the names of Katharina Lettau, the Society's long-time secretary, James Zimmerman, Maarit Threlfall, and Martin Conrad, all officers at one time or another and perpetually active members, come to mind. So, too, does the name of Ben Ashman, treasurer of the Society from 1963 through 1982. Ben's interest in phenology spanned half a century. He began keeping records of the "full bloom" of the lilacs at his Madison home in 1932 and continued to do so until his death in January 1983 at age 90. When Ben retired as treasurer, Jim Zimmerman noted that he "may well be our most faithful supporter in terms of service rendered."

The doldrums did indeed pass, and interest in phenology, and the Wisconsin Phenology Society, is on the upswing in the 1980s. Several groups, including the Milwaukee Audubon Society, the Northeastern Wisconsin Audubon Society and WLUK-TV in Appleton, and Friends of the Arboretum in Madison have published phenological calendars for public distribution in the last three years. So, too, did the River Bend Nature Center in Faribault, Minnesota, thanks to the work of one of the Society's out-of-state members.

Society President Marlin Johnson, a biologist at the University of Wisconsin Center in Waukesha, and 15 other people formed a southeastern chapter of the Society in 1982. Johnson urged members elsewhere to form their own regional chapters. His reason: "Phenology is too exciting to keep to yourself. Get together and share your enthusiasm."

Publicity about the Society in *Wisconsin Trails* magazine helped attract 52 new members last year, boosting the Society's ranks to 358 last spring. That figure included 29 people in other states and two in Canada. In the Society's first-ever winter newsletter this year, Marlin Johnson urged the new members to take their membership seriously and become active in the organization. He and others hoped the new blood would bring new vitality as well.

One could ask whether, 25 years later, the Wisconsin Phenological Society has lived up to the dreams of its founders – that group of scientists who huddled over the original idea back in 1959. The answer is a qualified yes.

Yes, the Society enlisted a network of volunteers from one end of Wisconsin to the other to gather the sorts of long-term data scientists need to uncover some of the still-unknown links between the biological and physical worlds. The network has never grown beyond modest size, and it does have gaps, but it exists and has performed commendably for two and a half decades.

Yes, the Society has amassed a considerable amount of phenological data, analyzed some of it, and published its findings for all to share. Its small budget (coming wholly from members' contributions) and total reliance on volunteers have kept the organization from producing the volume of scientific information that would be possible with more substantial backing. But again, given its resources, it has done well.

Ultimately, though, the Wisconsin Phenological Society need not answer to the ideals of its founders but only to itself. Do the people who <u>are</u> the Society find it worthwhile? Have they gained anything by its existence? Do they believe it should have a future?

Here, the answer seems to be an <u>unqualified</u> yes. The keen observer realizes that the Society has evolved into something far more than an instrument for scientific data collection. It is a group of people who appreciate nature in a special way, who see it from a different angle, who recognize more of its oft-hidden wonders, than everyone else.

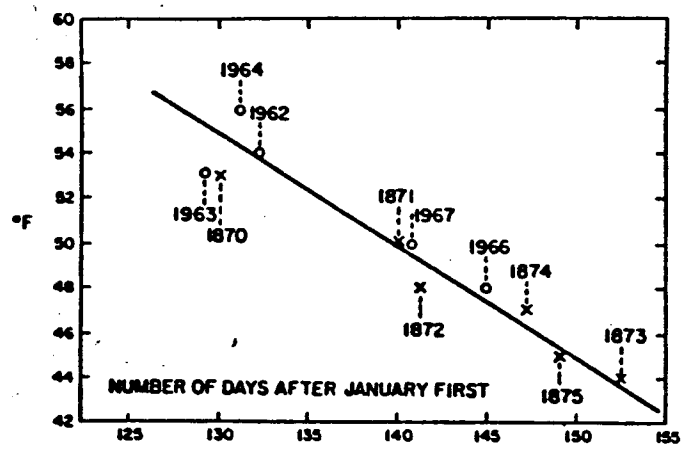
To be sure, it has its scientists, and they carry on the work that interests them – documenting and analyzing, correlating and synthesizing. But it also has its historians, its poets, its philosophers, and its plain, ordinary, everyday people, all of whom find inspiration in watching the cycles of nature and comfort in knowing that they are not alone.

Yes, indeed. There is good reason for the Wisconsin Phenological Society to be. And good reason for it to continue.

Whitford's from Wauwatosa. Mean monthly temperatures of April and May for each year and the flowering dates of lilac are shown below. Air temperatures for the recent period are those observed at Mount Mary College which is approximately one mile east of the site of Whitford's lilac observations. During the earlier period temperatures were recorded by the U.S. Weather Bureau station at the corner of Broadway and East Michigan Street.

	New Coeln – Father Bruhin							Wauwatosa – Professor Whitford					
Years	1870	71	72	73	74	75	Mean	1962	63	64	66	67	Mean
Mean April/May Temp.	53	50	48	44	47	45	47.8	54	53	56	48	50	52.2
Yearday of Lilac Bloom	130	140	141	152	147	149	143.2	132	129	131	145	142	135.8

Of course, it would have been more appropriate to relate degree-days for each season to the year-to-year variability of flowering dates. However, we are primarily interested here in relating differences in blooming dates to possible climate changes over decades. Uncertainties in the lilac data justify this somewhat coarse method. Bruhin failed to define his criterion for "lilac to be in bloom." At present, the date of "opening of the first flower" is recorded when on one bush in several places a few flowers are open because this stage requires a minimum of judgment on the part of the observer.



Dependency of Lilac Blooming Dates on the Average Temperature of April and May

The table and graph suggest the following: Firstly, April and May temperatures were much colder during the earlier period. The spring of 1966, which for the 1960s was very late and cold, would have been considered a normal spring in the 1870s; and vice versa, the spring of 1870, which Bruhin described as very early and warm, would be considered normal now. Of course, a sample period of six years cannot be conclusive, but in this particular case the conclusion is supported by independent evidence of a relatively cold climatic period about a century ago. Secondly, the straight line (computed by the method of least squares) implies that a decrease of one degree in temperature of the bi-monthly average corresponds to a two-day delay in the blooming date in either period within error of tolerance. The deviations from the straight line in 1963 and 1964 could be eliminated by averaging the April and daily May temperatures only up to the blooming date.

In summary: If a statistical relationship between phenological data and temperatures is derived using observations from recent years, it can be used as indicator of temperatures in former years for which only phenological data are available.

b: Early Phenology in Wisconsin

b1. Early observations from Milwaukee County

Katharina Lettau, Madison; 1989

One hundred and twenty years ago, on the first of May, 1869, Thomas Aquino Bruhin, a priest from Switzerland, arrived in Wisconsin to settle at New Coeln, then a village in Milwaukee County between Howell Road and the Milwaukee-Chicago-St. Paul Railroad. At present, the southeast corner of Mitchell Airport is in this vicinity. Father Bruhin, a learned biologist, expressed some dismay about the late arrival of spring in Wisconsin as compared to his native Switzerland. In a technical paper, published in Vienna, Austria, he wrote: "The ground was still bare on the first of May, only in sheltered places a few spring flowers had broken through the leaf-covered ground in the bush," as he called the wooded area. He identified *Anemone acutiloba* (hepatica), *Erythronium americanum* (yellow adder's tongue), *Cardamine rhomboidea* (bitter cress), and *Sanguinaria canadensis* (bloodroot). Dominant trees of the bush were oaks, maples and hickories.

Father Bruhin began to keep a log of phenological events, observing birds, amphibia, insects and plants. By placing an ad in the German-language paper, "Der Seebote" (Lake Messenger), he tried to encourage other nature-lovers to do likewise. He published the six-year record of his observations in the "Proceedings of the Zoological-Botanical Society of Vienna" (Vol. XXV, pages 633-634 and 811-813, 1875).

He was pleased to find a variety of orchids and many rare plants on his hikes through the "Stefan's bush" (southeast of New Coeln) and a tamarack swamp. It was the botanist's good fortune that the swamp dried out completely in the early spring of 1870, apparently for the first time since the area was settled. He reports that it was still difficult to penetrate the tangle of branches and roots of the fallen trees, some of which were lying there for centuries.

Bruhin had no meteorological instruments and made no weather observations except for a general remark about the "very early and dry spring of 1870." However, having arrived only the previous year, he may have been unaware of the actual mean conditions because his later records show that in 1870 almost all phenological events, normally occurring during March and April, were delayed. Only those normally observed in May were advanced which suggests that the dryness of the spring season may have been accompanied by a colder than usual late winter and a warmer than usual late spring.

Among the fifty-six different species Father Bruhin recorded from 1870-1875 are flowering dates of common lilac, the plant for which the Wisconsin Phenological Society had started a special observation program in 1960. From 1961 to 1966 members reported 44 lilac blooming dates. Philip Whitford (then professor of plant ecology at the University of Wisconsin-Milwaukee) reported blooming dates of the same bush in Wauwatosa from 1962 to 1968. It is interesting to compare the two sets from Milwaukee County separated by almost a century. No date is available from 1965 because a severe late frost killed all lilac buds.

A sprawling city like Milwaukee provides special problems for phenological studies. Being located near and on Lake Michigan one could expect a systematic retardation of flowering dates towards the shore because of the lake effect. As we know, air over land warms up in spring more quickly than air over water. This effect is borne out by temperature readings at two U.S. Weather Service stations in the area. Averages for 1960-1966 show that the air temperature at Mount Mary College (8 miles from shore) was one to two deg F higher in April and three to four deg F higher in May than at Mitchell Field (2 miles from shore). However, the lilac blooming dates do not show a dependency on distance from the lake shore, at least not for the material available for the 60's. The probable explanation is that hardly any of the observed bushes grow in the open; almost all are sheltered by housewalls or other bushes and trees. Common local factors like exposure to sunshine and shelter from wind appear to overrule the regional factor of distance from Lake Michigan.

In the following the dependency of lilac blooming on air temperature averaged for the months April and May will be summarized using the two sets of observations, Father Bruhin's from New Coeln and

b2. A bit of phenological history from Wisconsin

Katharina Lettau, Madison; 1982

Back in 1959, our society was the first organization to be founded with the primary purpose of collecting phenological data statewide. The emphasis is on "organization" and "statewide." Phenological events observed and recorded by individuals in Wisconsin date back more than 100 years. These were often published in little known journals. For example, the highly interesting records kept by Father A. T. Bruhin between 1870 and 1880 were published in the Milwaukee "Seebote" and in Vienna, Austria. Often noted and well-known are the data collected by Aldo Leopold and Sara Jones in Dane and Sauk counties from 1935 to 1945. And there were others.

Marvin Kosanke, a charter member of our society, brought to my attention a study, entitled "When the Leaves Appear and Fall," that was published in "Reports of the Agricultural Experiment Station of the University of Wisconsin," beginning in 1881. Under the direction of Prof. Henry and continued by William Trelease, the seasonal cycle of leafing was recorded for about 50 species of trees and shrubs in and near Madison. From their tabulations I extracted the 1884 data for common species that also are listed on our reporting sheet.

It could be a challenge to some of our members to observe the same phases 100 years later. Average monthly temperatures show that 1884 was a cold year compared to what we now call "normal." This is confirmed by the fact that Lake Mendota opened as late as April 15 and closed already December 17. "Normal" dates for 1950-1970 are April 5 and December 22.

DATES OF LEAFING, 1884

	Silver Maple	Sugar Maple	Red Oak
LEAVES:			
appear	30 Apr	12 May	10 May
about 2" long	12 May	15 May	16 May
about 4" long	20 May	20 May	22 May
fully developed	8 Jun	10 Jun	5 Jun
begin to fall	2 Oct	20 Sep	4 Oct
all fallen	1 Nov	4 Nov	20 Nov

c: Aldo Leopold's Heritage

c1. Aldo Leopold on phenology

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UW Arboretum Committee, Madison; 1987

The year 1987 marks the 100th anniversary of Aldo Leopold's birth.

Leopold always emphasized that in order to understand the natural world around us we must OBSERVE AND RECORD, activities that the members of our Society have pursued since 1959. No one has expressed this philosophy better than Leopold himself in the introduction to a "A PHENOLOGICAL RECORD FOR SAUK AND DANE COUNTIES, WISCONSIN, 1935-1945," published as Paper No. 8 in the Journal of the Arboretum of the University of Wisconsin. The Phenological Society gratefully acknowledges the Arboretum Committee's permission to reproduce the following excerpt in our newsletter. –K.L.

Each year, after the midwinter blizzards, there comes a thawy night when the tinkle of dripping water is heard in the land. It brings strange stirrings, not only to creatures abed for the night, but to some who have been asleep for the winter. The hibernating skunk, curled up in his deep den, uncurls himself and ventures forth to prowl the wet world for breakfast, dragging his belly in the melting snow. His track marks one of the earliest dateable events in that cycle of beginnings and ceasings which we call a year.

From the beginnings of history, people have searched for order and meaning in these events, but only a few have discovered that keeping records enhances the pleasure of the search, and also the change of finding order and meaning. These few are called phenologists.

The events comprising the annual cycle are innumerable. Wisconsin, for example, has about 350 species of birds, 90 mammals, 174 fishes, 72 amphibians and reptiles, 20,000 insects, and 1,500 higher plants. The life of each of these 22,000 species consists of a sequence of events, each a response to the advancing season. No one phenologist can hope to recognize, much less to record, more than a very small fraction of this prodigious drama.

Many of the events of the annual cycle recur year after year in a regular order. A year-to-year record of this order is a record of the rates at which solar energy flows to and through living things. They are the arteries of the land. By tracing their responses to the sun, phenology may eventually shed some light on that ultimate enigma, the land's inner workings.

Yet it must be confessed that with all its weighty subject matter, phenology is a very personal sort of science. Once he learns the sequence of events, the phenologist falls easily into the not very objective role of successful seer and prophet. He may even fall in love with the plants and animals which so regularly fulfill his predictions, and he may harbor the pleasant illusion that he is "calling shots" for the biota, rather than vice versa.

Phenologists are a heterogeneous lot, and have found shelter under diverse intellectual roof-trees. Thoreau, the father of phenology in this country, scorned any roof-tree but his own, hence his records (for the period 1850 to 1861) remained unpublished for half a century. Hough (1864) was a doctor of medicine, and the Bureau of Patents published his tables. Henry (1881) was an agronomist and a dean; the Board of Regents published his reports. Hopkins (1918) was an entomologist; the Weather Bureau published his findings. Among contemporary phenologists are botanists, foresters, game managers, ornithologists, range managers, and zoologists. Phenology, in sort, is a "horizontal science" which transects all ordinary biological professions. Whoever sees the land as a whole is likely to have an interest in it.

Phenology is more ancient than the "vertical" categories which it transects; its first paper, published about 974 B.C., cuts across three sciences then not yet born: meteorology, botany, and ornithology:

> For, lo, the winter is past,
> The rain is over and gone;
> The flowers appear on the earth;
> The time of the singing of birds is come
> And the voice of the turtle is heard in our land.
> (*Solomon*, 2:12)

c2. Excerpts from: Impressions of Aldo Leopold

James H. Zimmerman, Madison; 1987

Among several influential teachers, Aldo Leopold changed my life the most. Not just by broadening my interests from botany to wildlife and ecology, he was instilling in me a missionary drive to encourage others to involve themselves in the planetary ecosystem, for pleasure and profit.

The contagiousness of Leopold's current and diverse interests soon set me on two projects that I have followed all my life – phenological observations and the behavior of animals, especially birds. Typical of Leopold, these were new fields for him, and for science in general. I became a keen observer of nature because Leopold served as a role model who greatly enjoyed this pursuit.

Below his charismatic charm – a quiet thoughtful stance lightened at the right moment with a sparkle in his eye and an amusing observation – was the great depth of his commitment to scholarship and of understanding of nature and of people alike. With boyish enthusiasm he had to share any new discovery of fact or of interpretation with his class or with anyone who was near at the time. But that was just the "tip of the iceberg." He had a tremendous compulsion to figure things out.

When he found a place where the new puzzle piece fit into his evolving scheme of things, Leopold would brighten up and with obvious excitement try out his explanation on the others present.

I believe it was his joy of exploration combined with addiction to worrying at a topic until he had drained it of meaning that enabled Leopold to excel at many things from teaching to research to writing. In each phase of his life he built upon the old and polished a new facet of his personality: the hunter, the forester, the family man, the game manager, the administrator and board member, the naturalist, the conservationist, the investigator in pioneering fields of study, and the philosopher. Each was a transformation into something even more complex and beautiful – with never an ending, but always with new opportunities beckoning. These transformations were as much an inspiration to others who knew him as were the joy of discovery and the compulsion to figure things out.

One of his most conscientious pursuits was the cultivation of his audience – his students, and later his readers – as if they were his garden and his own children. Before a class he always had carefully thought out each question to ask of a particular student, tailoring it so the student could handle it from his or her experience and level of understanding, yet requiring a little growth in the course of answering it. And he always had each student in for a personal conference in which, to put the student at ease, he would start by asking for advice on something he was working on.

Characteristically a thoughtful person, Leopold believed managers and researchers must be brought together to overcome the isolation and animosity that breeds from specialization. After he died, the two camps never again met regularly on campus.

His gift, behind all the complexity of his personality, was I believe, a special spark of kinship made up of both intellectual and emotional enthusiasm for all things, including people. Like a skilled campfire builder, he would fan each person's spark into flame. His presence, whether in person or in writing, worked a spell, quietly and unobtrusively, that grew and grew over time.

Many critics debate Leopold's effectiveness in his time and the integrity of his conservation philosophy. I prefer to see his great achievement to be that of a highly successful augmenter of involvement by others.

3 ABOUT NATURAL SCHEDULES OF FLOWERING

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a: Triggers of Plant Blooming

a1. Blooming confusion

Wayne R. Pauly, Madison; 1977

What triggers plants to flower? Why does New England aster always bloom in the late fall? So late, in fact, Indians called it, "it-brings-in-the-frost." Why does shadbush bloom in early spring? New England settlers depended on its flowers to remind them shad were running, a welcome source of fresh food after a long winter.

The lengthening days of spring and the shortening days of summer trigger the flowering of hundreds of our plants. Red clover blooms in spring when daylight exceeds 12 hours, and scientists call it a long-day plant (LDP). In late summer, ragweed blooms when days shorten to less than 14.5 hours, and it is called a short-day plant (SDP). Notice that LDP and SDP refer to daylight longer than a critical period and daylight shorter than a critical period. LDP's bloom before summer solstice (June 22) and SDP's bloom after.

Two U.S.D.A. biologists, W.W. Garner and H.A. Allard, discovered the relationship between daylength and blooming. In 1920 they tried to cultivate Maryland Mammoth tobacco in Washington D.C. but had problems because the seeds wouldn't mature. After several blind alleys, they found that daylengths less than 12 hours triggered flowering. The experiment made them famous although it failed to solve the problem with tobacco seed production.

This discovery occurred over 50 years ago, and yet we still don't understand how these plants measure time. We do know, though, that plants measure night-length and not day-length. A simple experiment with chrysanthemum proved this. Chrysanthemum, a short-day plant, was prevented from blooming by interrupting the night period with a few minutes of light. Interruptions of the day period with a few minutes of darkness had no effect. The cut flower industry uses this to save on lighting bills. They used to delay flowering of SDP's by extending daylight, now they interrupt the night.

We also know that flowering is caused by a hormone called florigen. It hasn't been isolated, but its behavior was shown by experiments with cocklebur, a common weed. The hormone is produced in the leaves during the critical period of darkness and moves to the growing tips in daylight.

Garner and Allard discovered a third group of flowering plants. They called them day-neutral plants because daylength didn't control their flowering. Many spring flowers are day-neutral, they are triggered to flower by cold winter temperatures followed by warm weather. Certain types of corn bloom when they have a minimum number of leaves. Many plants are triggered by the interaction of several factors, including sufficient moisture, warm temperatures, cold temperatures, food reserves, soil temperatures, etc.

We know little about the factors which regulate growth in our native plants. For example, we know that warm temperatures stimulate growth in spring flowers, but we don't know the exact requirement for individual species. You could learn about the requirements of your favorite species with a thermometer and a notebook. Record soil temperatures this spring near your favorite flowers. Discover when frost leaves the ground and how soon afterwards your plants begin growing. Continue recording temperatures until the plants flower. Compare growth rates and temperatures over several years. These observations will bring you closer to your plants and can increase our understanding of what controls the sequence of blooming.

a2. The Phenology of flowering plants

Keith Wendt, Madison; 1980

In the wetlands, it's the skunk cabbage pushing through the snow.

In the prairie, it's the pasque flower.

In the forest, it's Dutchman's breeches, hepatica and bloodroot that bring in the spring.

Each week, new wildflowers bloom and old ones fade, until the graceful gentian and goldenrod make a final stand against the coming October frost.

The phenology of flowering always has intrigued naturalists. From the Tundra to the relatively non-seasonal Tropics, plant communities appear to have an even blooming distribution throughout the growing season. Romantically, we may view this timing as nature's way of providing human inspiration. Thinking more biocentrically, we may see a complex story of struggle and adaptation to the environment.

It has long been postulated that plants actively compete for pollinators, just as they compete for physical resources such as sunlight, water and nutrients. In most plant communities, pollinators such as bees, moths and flies, seem scarce compared to the number of flowers which require their services.

What happens when two plants compete for the same limited pollinator?

The pollinator is attracted to that flower which offers the greatest rewards, such as the large concentrations of nectar, sweeter scents or brighter colors. The poorer competitor, left largely unserviced, suffers a severe reduction in seed set. In order to survive, it must evolve strategies to escape intense competition. One survival strategy is for less efficient competitors to bloom at times when their superior competitors are not. Hence, potential competitors avoid direct competition by taking turns using the same pollinator.

Active competition for pollinators seems to play an important role in determining the date and duration of blooming periods in our plant communities. We are not surprised to see in complex biological communities that every possible blooming time is filled.

Within a community those plants which possess similar floral structures almost always attract the same pollinators. If there is indeed competition between plants for pollinators, one would expect such plants to have non-overlapping blooming times in order to avoid deleterious competition. Pollination ecology studies have shown this staggering of bloom to be quite common. For example, in east-central Illinois, the six species of phlox which have nearly identical flowers avoid competition by staggering their flowering times. Phlox bifida blooms in early May; P. divaricata, in mid-May; P. pilosa, late May; P. maculata, early June; P. glaberrima, mid-June; and P. paniculata, August.

In our bog communities, we find the many species of ericaceous shrubs show this same phenomenon of non-overlapping flowering periods. These bog plants have very similar flowers and their seed production is dependent upon visitation by the same hymenopteran pollinators. These facts indicate the bog ericads are maximizing flower pollination by occupying different blooming periods and avoiding competition for the same pollinator at any one time.

Divergence in flowering time is not the only way plants avoid competition for pollinators. Nature provides a rich array of possible adaptations for existing in any particular environment. Plant species which bloom simultaneously in the same habitat, as a rule, tailor their flowers to lure different pollinators. For example, plants with flowers adapted for bee or butterfly pollination do not compete with flowers fitted for flies or those specialized for hummingbird pollination. In this way, competition for the same pollinator is avoided and coexistence is achieved.

The divergence of flower phenology and form is a complex example of adaptation: a marvelous strategy employed by plants to avoid competition and share the scarce pollinator resource more efficiently.

As the skunk cabbage eases toward the sun, the wildflower community prepares to unfold, not all at once on the first warm day, but each new face in its own time. In our prairie communities one can witness approximately 17 new species coming into flower each week from early April to late October. Pollination ecology studies are revealing this unfolding of flowering as a complex evolutionary response to the dynamic relationships among plants and pollinators.

a3. Degree-Day Triggering of Lilac Flowering
Katharine Lettau, Madison, 1969, 1975

It is not adequately known which specific factors of the physical environment trigger phenological phases of perennial plants. Conventionally, one assumes that after breaking dormancy in early spring a certain sum of thermal units is necessary to produce flowering. The accumulation, or dosage, depends on a selected threshold temperature as well as a starting date of summation. We may denote these two parameters by T* and D*, respectively. Both can be evaluated empirically after stages of plant development are observed over several years with different seasonal trends of environmental temperature which will be denoted by T'. Most often, one uses (Tmax+Tmin)/2 for T', that is the daily records of maximum and minimum temperatures. Occasionally, thermograph recordings are evaluated, yielding "degree-hours."

Let DD denote the accumulated degree-days. At any date after D*, DD changes at the rate of T'-T* per day, usually increasing during the growing season but with occasional decreases on early spring days where T' is smaller than T*. The accumulation is terminated at the date at which the selected phenological phase is triggered. This method produces conclusive results if terminal DD values for a given phenological event agree with each other, regardless of the year and the locality within a region.

An estimate for the terminal DD-value which triggers common lilac FF in Wisconsin was based on phenological observations bewteen the years of 1961 and 1974. FF-Data from the south-central district (observed by Mr. Ashmann, Madison, Dane County) and from the north-central district (observed by Mr. Indermuehle, Manitowish Water, Vilas County) were combined with T'-data from the US Weather Service stations at Truax Field, Madison, and Rest Lake, Vilas County, respectively.

The appropriate starting date of DD-accumulation for lilac FF was empirically derived as the year-day or date when in the climatic mean trend from winter to summer the temperature crossed the 35 F value. This happened to be March 25 at Madison and April 7 at Rest Lake. Several tentative threshold temperatures were tested. It turned out that using 35 F minimized the relative variance of terminal DD values for lilac FF observations in both districts.

Common lilac FF occurred when the multi-annual averages of terminal degree-days amounted to 513±23 in Dane County and 526±20 in Vilas County. These results for the two widely separated counties agree satisfactorily with each other. It may be concluded that for Wisconsin an average of DD = 515 applies when regionally appropriate dates for D* are used with a uniform T* value of 35 F. A standard deviation of plus-minus 20 degree-days at normal May temperature of T' around 55 F corresponds to plus-minus one calendar day.

Occasionally, there are years when lilac FF occurs at an exceptionally high terminal DD-value. For example, 580 degree-days were needed in May 1967 in Madison. My experience suggests that after about 450 degree-days are accumulated in early May, lilac FF is triggered only when the following days have relatively high maximum temperatures.

a4. A half-century of lilac bloom dates in Madison

Katharina Lettau, Madison; 1984

Ben Ashmann has rendered faithful service for 19 years as treasurer of the Wisconsin Phenological Society. He lived in a residential section of the city of Madison, south of Lake Monona. His homestead at Waunona Way included an orchard with a variety of apple trees, populated by honey bees. Along one street front the orchard is hidden behind an unbroken tall hedge of lilac bushes, offering a spectacular sight at full bloom. Starting with 1932, Ben Ashman recorded annually the date of "Full Bloom" of his lilacs, noting that this event was later by several days than "First Flower" which he began to record after 1961, the year the Phenological Society was created and started its lilac observation project. For half a century after 1932 the dates reported are for the same planting.

Because of the impressive length of the record, a tabulation of this unique contribution to the phenology of Wisconsin follows. Even a faithful observer will miss one or several years. Missing dates before 1961 are left blank. For the later years, three missing dates were filled in from other observers in Madison and are indicated by *.

Positive numbers give days after April 30; negative numbers give days before May 1.

Year +:	0	1	2	3	4	5	6	7	8	9
1930			16	20	10	25	12	23	-6	15
1940	23		5	18				23	8	5
1950		16	6	21				9		
1960		20	8	7	6	12	24	18	1	7
1970	8	12	19	13	12	-5	5	-8	18*	12
1980	14*	4	9*							

The data show that the earliest bloom occurred April 23, 1977, and the latest on May 25, 1935. During this interval of nearly five weeks, the number of times of bloom was:

April 23 through 30	3
May 1 through 5	5
May 6 through 10	10
May 11 through 15	8
May 16 through 20	8
May 21 through 25	6

As is true for other phenological spring events, this statistical distribution is skewed. In the interval of about two weeks from earliest to most probable date (May 8) there are only 12 dates; in an interval of about three weeks following May 8, 25 dates are recorded.

b: About Flowers Timed to Bloom on Holidays

b1. Fourth of July flowers

James H. Zimmerman, Madison; 1980

In the oak woods of southern Wisconsin, several flowers seem to come out very dependably around the fourth of July each summer. None is particularly conspicuous, but if you look at them closely, these flowers have their own special beauty. They are:

Lopseed (*Phyrma leptostachya*) - pale pink
Enchanter's Nightshade (*Circaea quadrisulcata*) - white
Agrimony (*Agrimonia gryposepala*) - yellow
Tick Trefoil (*Desmodium glutinosum*) - pink

All four plants happen to share the production of hooks or burrs on their fruits which catch rides on all furry and human seekers of berries, nuts, or game. Three evergreen plants, more common in the north, also bloom in early July: the fragrant white shin leaf (*Pyrola elliptica*), the veined-leaved rattlesnake plantain orchid (*Goodyera pubescens*), and the shiny leaved pipsissewa (*Chimaphila umbellata*). Perhaps readers familiar with the northern forest know of other dependable midsummer flowers.

Not all early July flowers occur in woodlands. In the garden, certain kinds of phlox, bellflowers, clematis, and others start faithfully every year close to Independence Day. In the fields, you find chicory and the delicate tiny "Christmas tree" heads of red-top grass about this time. There is little variation in flowering time from year to year in these flowers. Why?

These are classified as long-day plants. Like many species flowering in June, they initiate their flower primordia when the days become long and the nights short. In the winter, you can get long-day plants to flower in the greenhouse by breaking up the night into two shorter periods with a short period of artificial light. Evidently the hormone balance on the long-day plant is shifted into "flowering" gear when the dark periods become short. June flowers appear earlier than July flowers for possibly one of two reasons: (1) they both start forming in May when the nights reach a critical shortness; but the July flowers need a longer development period than the June flowers. (2) the July flowers need an even shorter dark period than the June species to trigger flower initiation.

Since the summer is rather dependably warm, summer flowers are not much affected by the weather; they usually bloom within a day or two of their average date. Fall flowers, likewise, are punctual, responding as they do to longer nights and flowering soon after being triggered. Since fall (short-day) flowers have another constraint—the imminence of frost—they tend to have a short development period and may even be hastened by cool weather. One early spring we had the bur marigold (*Bidens cernuua*), a fall annual, flowering in June on the marsh edges; they had germinated in early April and reached flowering stage before the days had become too long to prevent flower initiation.

It is the spring flowers that are the most variable and hence useful as indicators of early season warmth. They are really short-day plants, forming their flower buds after midsummer. Their need to flower early is met by having the flowers (and leaves, too) completely preformed by the previous fall. Occasionally violets and apples will actually flower in autumn if mild weather follows enough cold to break dormancy of the buds. No wonder the spring flowers and tree leaves come out so fast in May! All they need is heat and water for rapid expansion.

b2. Pasque flowers may bloom at Easter time
Katharina Lettau, Madison; 1988, 1992

Etymologically, "pasque" is derived from the French. Many people believe that it may be a version of the modern French word for Easter, which is "paque." Judging simply by the range between earliest and latest blooming dates of the pasqueflower in Wisconsin, it could very well be taken as an "Easter Flower."

Easter is celebrated on the first Sunday after the full moon which occurs after March 21. Easter, therefore can occur between March 22 and April 25, inclusive.

Pasqueflower is listed on the Society's reporting sheet. Noteworthy are the records kept by the late Professor Herbert M. Clarke of the University of Wisconsin. For 22 years beginning in 1958, he noted the precise opening date of pasqueflowers growing on a limestone bluff on his property in Middleton in Dane County.

The earliest bloom occurred on March 20, 1973; the latest date is April 15, shared by 1960, 1975, and 1978. The 22-year average is April 3, with a standard deviation of ± 8.3 days. Except for one day at the earliest date, the range of pasqueflower bloom in Middleton is within the range of Easter celebration. Of course, there is only random coincidence in the variability of the two events from year to year.

However, there is a remarkably strong correlation between these pasqueflower blooming dates and the opening of Lake Mendota in Madison. More about this in Section 6b3.

c: Geographic Pattern of Phenologic Events

c1. "First-Flower" of lilac, from South to North in Wisconsin

Katharina Lettau, Madison; 1978

The 14 observers listed below have reported "First Flower" dates of common lilac (*syringa vulgaris*) from 1961 to 1978. This 18-year period was divided into two consecutive 10 year periods with 1969 and 1970 overlapping. Interesting is that in the second period the mean flowering date was advanced by 2 to 3 days in the northwest and northeast districts of the state.

District	County (Town)	May-Date of Bloom 1961-70	1969-78	Difference in Days	Observer
Northwest	Burnett (Grantsburg)	21	18	-3	Stone
"	Rusk (Weyerhauser)	23	20	-3	Anderson
"	Douglas (Lake Nebagamon)	30	28	-2	Wahlquist
"	Bayfield (Ashland)	29	27	-2	Gilles
Northeast	Marinette (Marinette)	24	22	-2	Saeman
"	Marinette (Peshtigo)	23	23	0	Lindberg
East-Central	Winnebago (Oshkosh)	24	22	-2	DiVall
"	Fond du Lac (Ripon)	18	16	-2	Kosanke
"	Calumet (New Holstein)	18	18	0	Erbach
"	Outagamie (Appleton)	16	16	0	Kurtyko
Central	Green Lake (Dalton)	14	14	0	Knight
West-Central	Monroe (Tomah)	14	13	-1	Pingle
South-Central	Dane (Madison)	11	10	-1	Ashman
Southeast	Washington (West Bend)	18	21	+3	Cypher

Monthly temperatures for the nine districts of Wisconsin were obtained from the State Climatologist's office. Computations of 10-year averages for the two periods showed that the average May temperature in the northern districts were about 1.5° F higher in the 70's than in the 60's. No significant temperature differences were found in the northern districts for April, nor for May and April in the southern districts. No explanation can be given for the three days delay in Washington County.

These findings confirm previously established results: If April-May temperatures are higher by 1° F, the lilac bloom is advanced by two days. The temperature difference of 1½° F between the two 10-year periods resulting in an advance of lilac bloom by two to three days supports the conclusion that lilac blooming dates are indicators of climatic mean temperatures of late spring in a given region.

c2. Phenophases of lilac development in Wisconsin
Katharina Lettau, Madison; 1972

Data on three stages of COMMON LILAC bloom in 1969, 70, and 71 from 10 Wisconsin counties are summarized below. The counties are arranged by districts. Three-year means for northern, central and southern districts are computed. Bloom duration is "End of Bloom" date minus "First Flower" date. In the columns for "First Flower" and "Peak Bloom" the numbers are days after 1 May.

	First Flower			Peak Bloom			Bloom Duration		
District, County	69	70	71	69	70	71	69	70	71
NE, Marinette	22	21	24	27	26	31	17	19	19
NW, Burnett	15	24	15	18	31	22	17	16	27
NW, Bayfield	22	35	19	28	40	34	19	12	14
NW, Douglas	26	27	31	29	43	36	17	14	17
3-year Mean:	23 May			30 May			17.3 days		
EC, Calumet	16	16	20	24	22	29	19	12	20
EC, Outagamie	15	13	16	22	19	25	19	21	22
WC, Monroe	13	10	15	15	18	21	16	16	17
3-year Mean:	15 May			22 May			18.0 days		
SE, Washington	15	18	27	27	24	35	23	11	12
SE, Walworth	8	10	16	16	18	20	21	16	18
SC, Dane	7	8	12	13	11	18	20	12	13
3-year Mean:	13 May			20 May			16.2 days		

Leaf development started early in the spring of 1971. During the third week in April temperatures reached the 70s and 80s in all districts of the state and the number of growing degree days was far above normal. Lilac buds were showing and an early blooming date looked likely. Then a pronounced cold front crossed the state (temperatures dropped 30 degrees within an hour), followed by a period of cold and wet weather which retarded further development. Buds did not open until the second week in May in southern Wisconsin, which is about normal for Dane County.

Compared with the two previous years, lilac bloom in 1971 began later in southern and central Wisconsin. In the north, it occurred later than in 1969 but earlier than in 1970.

In Outagamie County the Brenneke's (see Section 4.5) have faithfully observed the developmental stages of one lilac bush over the years. The bush is on their property in Hortonville. It was 13 feet tall in 1971 and 15 feet in 1980. Five stages were observed, four of them complete for the full decade. The summary below shows that is takes on the average 25 days from leafing to flowering, 8 days more to full bloom, and 10 days more before the display vanishes.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Mean
First bud has leafed	4/17	4/30	4/17	4/29	5/02	4/06	4/11	4/25	4/20	4/19	20 Apr
95% of buds have leafed	-/-	-/-	4/25	-/-	-/-	4/17	-/-	-/-	4/26	5/01	--
First flower open	5/16	5/17	5/19	5/19	5/19	5/22	4/30	5/19	5/17	5/11	15 May
Peak or full bloom	5/23	5/21	5/30	5/29	5/22	5/20	5/09	5/26	5/27	5/13	23 May
95% of flowers have withered	6/07	6/03	6/09	6/02	6/02	6/03	5/20	6/01	6/02	5/30	2 Jun

In Scandinavia, Waupaca County (see Section 4.7) Mrs. Robert Rasmussen has observed and reported a corresponding set of lilac data. The ten years of observations summarized below are from 1975 through 1985 (no data for 1976).

	1975	1977	1978	1979	1980	1981	1982	1983	1984	1985	Mean
First bud has leafed	4/18	4/11	4/21	4/23	5/17	4/10	4/15	4/26	4/23	4/18	18 Apr
95% of buds have leafed	4/20	-/-	-/-	4/26	4/19	4/12	4/17	4/27	4/27	-/-	23 Apr
First flower open	5/21	5/02	5/19	5/22	5/13	5/13	5/07	5/27	5/20	5/03	15 May
Peak or full bloom	5/24	5/13	5/26	6/01	5/24	5/27	5/19	6/05	5/30	5/10	24 May
95% of flowers have withered	6/03	-/-	6/03	6/09	6/01	6/03	5/30	6/14	6/10	5/24	2 Jun

The sets of mean dates for the two stations agree with each other very closely. This is not surprising in view of small differences in geographic coordinates as documented in the table in Section 4a2. There is also relatively close agreement with the two lilac phase dates at DePere listed as part of the Brown County chronology in Section 4b8.

In 1969, a special, six-stage, observational program was organized. "First Flower" (FF) was defined as the date when at least one floret was open on several clusters and "Peak Bloom" (PB) as the date when at least 90% of all clusters were fully open at the same bush.

From the 1969 special program a homogeneous sample of sixteen reports originated in fairly even distribution within a rectangular area, about 200 km wide and stretching for about 400 km towards NNE. A WNW-ESE running baseline intersected the Wisconsin-Illinois border near the Mississippi River. To express the results numerically, the migration velocity was determined statistically with the aid of the "least-error-squares." Results are:

	First Flower	**Peak Bloom**
Probably date of occurrence		
At baseline:	28 April	4 May
400 km NNE of baseline:	3 June	7 June
Probable error of event (in days):	± 3.1	± 3.4
Velocity of migration towards NNE in km/day:	11.8	12.6

The easternmost counties are disregarded where the isophanes are distorted due to the vicinity of Lake Michigan.

c3. About Hopkins' Rule

Heinz H. Lettau, Madison; 1992

Andrew Delmar Hopkins was a forest entomologist at the U.S. Bureau of Entomology, Washington, D.C. In 1918 he wrote a study entitled "Periodical events and natural law as guides to agricultural research and practise." The voluminous work was published as Supplement No. 9 of the Monthly Weather Review. At that time the Weather Bureau was part of the U.S. Department of Agriculture. Hopkins introduces the subject by discussing folklore as early natural guides for finding the best time to start periodical farm or garden work. The primary objective of his investigations was to develop numerical rules based on seasonal control of climatic temperature. Hopkins studied seasonal life activity and periods of rest. The subjects included (a) forest and shade trees, fruit trees, wild and cultivated shrubs and crops on farmfields and gardens, and (b) insect life related to plant developments. Hopkins made personal observations in nearly every state in the Union, but most of his special studies were made on his farm in West Virginia.

The following is a verbatim quotation from page 9 of Hopkins' 1918 publication:

> "The results of the investigations by the writer, supplementary to those by other investigators in this and other countries which have a general bearing on the subject of natural guides to agricultural research and practice, led to the conclusions, that:
>
> 1. The periodical phenomena of plants and animals are in response to the influence of all of the complex factors and elements of the climate as controlled, primarily, by the motions of the earth and its position relative to the influences of solar radiation.
> 2. The variations in the climate and consequent variations in the geographical distribution and periodical activities of the plants and animals of a continent are controlled by the modifying influences of topography, oceans, lakes, large rivers, and of other regional and local conditions, and the amount and character of daylight, sunshine, rain, snow, humidity and other elements and factors of a general and local nature.
> 3. There is a tendency toward a constant rate of variation in the climatic and biological conditions of a continent as a whole in direct proportion to variation in geographical position as defined by the three geographical coordinates: latitude, longitude, and altitude.
> 4. Other conditions being equal, the variation in the time of occurrence of a given periodical event in life activity in temperate North America is at the general average rate of 4 days to each 1 degree of latitude, 5 degrees of longitude and 400 feet of altitude, later northward, eastward and upward in the spring and early summer, and the reverse in late summer and autumn."

References to "Hopkins' Rule" appeared in the Manual of the Wisconsin Phenological Society and in several Newsletter articles. Frequently, the rule is simplified by stating that phenological events are delayed by 4 days per degree of N-latitude and 1.25 days per degree of E-longitude. Usually ignored are effects of altitude and that Hopkins restricted these numerical delay rates to spring and early summer in regions <u>without</u> modifying influences of topography.

Wisconsin's climate is significantly influenced by two of the Great Lakes. Periodical plantlife events in the eastern districts are conditioned by Lake Michigan towards the East, and in the north-western districts by Lake Superior towards the North. A statistical analysis of phenological observations in Wisconsin will be used to clarify the role of geographical variations and to find numerical approximations for the two "lake effects."

The 18-year means of lilac bloom at the sites of 14 observers given in Section 3c1 are reproduced below. Added are geographic coordinates. The original listing is rearranged according to geographic latitude. The five sites located in westerly districts are separated from the nine in central and eastern districts of Wisconsin.

District, Town	Latitude Y (deg)	Longitude X (deg)	Altitude Z (100 ft)	BD = Blooming Date Day of May, 1961/1978
W, Ashland	46.6	91.0	6.6	28.0
NW, Grantsburg	45.7	92.7	9.0	19.5
NW, Lake Nebagamon	45.5	91.6	11.5	29.0
NW, Weyerhauser	45.4	91.4	12.0	21.5
WC, Tomah	43.9	90.5	9.6	13.5
[NW,WC]-Averages:	$45.4 = Y^1$	$91.4 = X^1$	$9.7 = Z^1$	$22.3 = BD^1$
NE, Marinette	45.1	87.6	6.0	23.0
NE, Peshtigo	45.0	87.7	6.1	23.0
EC, Appleton	44.2	88.4	8.0	16.0
EC, Oshkosh	44.1	88.6	7.6	23.0
EC, New Holstein	43.8	88.2	9.4	18.0
EC, Ripon	43.7	88.5	9.1	17.0
C, Dalton	43.6	89.2	8.3	14.0
SE, West Bend	43.4	88.2	9.0	19.5
SC, Madison	43.1	89.3	8.6	10.5
[NE,SC]-Averages:	$44.0 = Y^{11}$	$88.4 = X^{11}$	$8.0 = Z^{11}$	$18.2 = BD^{11}$
14-Station-Averages:	$44.5 = Y^*$	$89.4 = X^*$	$8.6 = Z^*$	$19.7 = BD^*$

Latitude Y, longitude X and altitude Z are the independent variables, lilac blooming date BD is the dependent variable. A statistical regression analysis yields the numerical coefficients with which the departures of the independent variables from their means (denoted by ^{1}, ^{11}, and *, respectively) must be multiplied to express the departure of BD from its mean. Results are shown below for the five sites in western districts and the nine sites in eastern districts. For comparison, the numerical coefficients of Hopkins' rule are employed for all fourteen sites. The $\pm$ numbers attached to each formula are standard deviations of observed minus computed blooming dates in days.

Western Districts: $BD - BD^1 = 5.8(Y-Y^1) - 1.50(X-X^1) + 0.9(Z-Z^1) \pm 2.8$

Eastern Districts: $BD - BD^{11} = 3.3(Y-Y^{11}) - 2.30(X-X^{11}) + 0.0(Z-Z^{11}) \pm 2.3$

Hopkins' Rule: $BD - BD^* = 4.0(Y-Y^*) - 1.25(X-X^*) + 1.0(Z-Z^*) \pm 3.0$

For the western districts the effect of Lake Superior in the north is evidenced by the relatively large coefficient of $Y\text{-}Y^{1}$,. For the eastern districts the effect of Lake Michigan in the east is evidenced primarily by the relatively large coefficient of $X\text{-}X^{11}$.

Moreover, the relatively small Y-factor of 3.3 days per deg northern latitude expresses a tendency to equalization of blooming dates parallel to the lake shore. The geographical distribution of delays in lilac blooming is confirmed by the curvings and gradients of isophenes on maps shown in Section 6c2.

Station altitude has no effect in the east and is of relatively small importance only in the northwest. In comparison with Hopkins' Rule, the prediction of lilac blooming dates using specialized regional parameters improves the result only slightly. This is evidenced by the nearly equal values of the standard deviations. However, this may be true only for a month-of-May event. One has to keep in mind Hopkins' statement that delays in spring and early summer are reversed in late summer and autumn.

This restriction implies that northward delay of phenological events decreases from early spring to early summer. For example, comparison of the chronologies for Madison and Ashland (see Sections 4b2 and 4b4) suggests a delay of about four weeks in March/April, but only one week in June. During April through May, the delays decrease consistently from three to two weeks for the succession of spring events. The difference in geographic latitude of 3.5 deg between Madison and Ashland corresponds to two weeks delay according to Hopkins' factor of four days per 1 deg latitude. Hopkins suggests no delay in summer followed by a reversal to northward advances of phenological events during fall and early winter.

The corresponding reversal during midwinter can be documented by data on lake ice. Closing and opening of Wisconsin lakes are also reported by members of the Wisconsin Phenological Society. Detailed results shall be discussed in Section 5a1. Briefly, reports for two of the stations in the data table on lilac bloom may be used: Lake Nebagamon in comparison with Madison's Lake Mendota. The northern lake freezes in November-December about three weeks earlier and opens in April about two weeks later than Mendota which is 2.4 deg farther south. In his original analyses, Hopkins did not provide numerical estimates for lake phenology.

The predicted eastward retardation of spring events beyond Lake Michigan was tested by K. Lettau (Fall 1979 Newsletter), using data from Burlington, Ontario, and Madison, Wisconsin. Lilac and spirea are chosen because the flowers of these shrubs are well above the airlayer of microclimatic local effects.

	Madison	**Burlington**	**Eastward Delay**
COMMON PURPLE LILAC, FF			
1977 (year with early spring)	19 Apr	10 May	21 days
1978 (year with late spring)	18 May	24 May	6 days
BRIDLEWREATH SPIREA, FF			
1977 (year with early spring)	6 May	21 May	15 days
1978 (year with late spring)	26 May	31 May	5 days

Burlington lies close to 10 deg longitude east of Madison on about the same geographic latitude. Hopkin's Rule suggests a delay of 12.5 days. The overall average of the four delays is close to 12 days and thus close to Hopkins' empirical value. Note that delay-averages are in line with Hopkin's restrictions. Moreover, the effect of the character of individual years is confirmed: the mean delay is 18 days for the year of 1977 with early spring, but only 5.5 days for the year of 1978 with late spring development.

4 PHENOLOGICAL CHRONOLOGIES

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a: Background

a1. Introductory remarks
Katharina Lettau, Madison; 1977, 1992

The phenologic chronology of Washington County was published in the 1977 Spring Newsletter. It was the first of a series of chronologies for nine counties, published between 1977 and 1987. The table in 4a2 provides the observer's name, location, county, geographic coordinates, the district of the state of Wisconsin and the years of data collection used.

It would be ideal if phenological records were available for full decades in the same manner as temperature and precipitation station observations are organized for climate surveys. This would facilitate to study how closely phenologic events depend on weather and climate. Yet, continuous 10-year records of phenological data are still sparse.

During the 1970's and 80's between 10 to 15 percent of the annual "Reporting Forms" were returned from members. Selected for chronologies were reports which covered a sizable number of events for about ten years of observations. The exception is the first chronology for Washington County. On request, the observers wrote a description of the topographic features of their locale. Parts of the responses were published with the summaries. I contributed remarks on local climate.

In Chapter 4b the original summaries are considerably abbreviated and the site descriptions were edited. Excerpted are only the multi-annual average, the earliest and latest date of "First Flower" for plants, and "First Notice" for other events. Plants are listed as "common" if reported for at least half of the nine sites. Additionally listed are plants of special interest to an individual observer or characteristic for the locale.

In Chapter 4c data on shrubs and trees, also special chronologies of mushroom plicking and the statewide variability of selected spring events are given.

a2. Station information

Katharina Lettau, Madison; 1992

Observers and site information for the nine locations in the state for which observations by members of the Wisconsin Phenological Society are summarized in Chapter 4b.

	OBSERVER Location	County	Lat. deg N	Long. deg W	Elev. ft.	Wisconsin District	Rep. Period Years
1.	Eva Brown Fredonia	Washington	43.5	88.0	795	Cent. East	1970-1976
2.	Mrs. J. Gilles Ashland Area	Bayfield	46.6	91.0	650	North West	1968-1976
3.	Alonzo Pond Minocqua	Oneida	45.9	89.8	1590	North Cent.	1959-1974
4.	Katharina Lettau Madison	Dane	43.1	89.3	850	South Cent.	1971-1980
5.	The Brennekes Hortonville	Outagamie	44.3	88.4	226	Cent. East	1967-1982
6.	Helen Illichman Antigo	Langlade	45.2	89.2	1500	North East	1974-1984
7.	Mrs. R. Rasmussen Scandinavia	Waupaca	44.5	89.1	930	Cent. Cent.	1975-1985
8.	Edwin Cleary DePere	Brown	44.8	88.0	600	Cent. East	1969-1985
9.	Kathleen Ela Rochester	Racine	44.3	88.4	230	Cent. East	1967-1982

b: Chronologies for Plants and Garden Events

b1. Washington County

Excerpts from Newsletter of Spring 1977

Dates:	Average	Earliest	Latest
FF, COMMON List			
Crocus	9 Apr	3/25/73	4/22/76
Scilla	20 Apr	4/07/76	5/01/72
Marsh Marigold	21 Apr	4/09/76	5/01/75
Dutchman's Breeches	25 Apr	4/16/76	5/02/75
Bloodroot	27 Apr	4/16/76	5/05/75
Dandelion	29 Apr	4/17/76	5/09/72
Trillium (Showy)	8 May	4/23/76	5/16/70
Wild Geranium	19 May	5/16/76	5/23/76
Orange Hawkweed	10 Jun	6/03/70	6/21/71
Milkweed	5 Jul	6/30/75	7/13/63
FF, SPECIAL List			
Asparagus (2")	5 May	4/26/76	5/25/72
Wild Blue Phlox	24 May	5/16/76	5/29/72
Blue Spiderwort	30 May	5/26/75	6/04/75
OTHER EVENTS			
Frost out of ground	4 Apr	3/14/73	4/14/70
Chorus Frog heard	6 Apr	3/26/73	4/18/75
Earthworm castings seen	17 Apr	3/29/76	4/27/72
Bumble Bee seen	4 May	5/01/75	5/16/72
Cicada heard	3 Aug	7/10/71	8/26/76

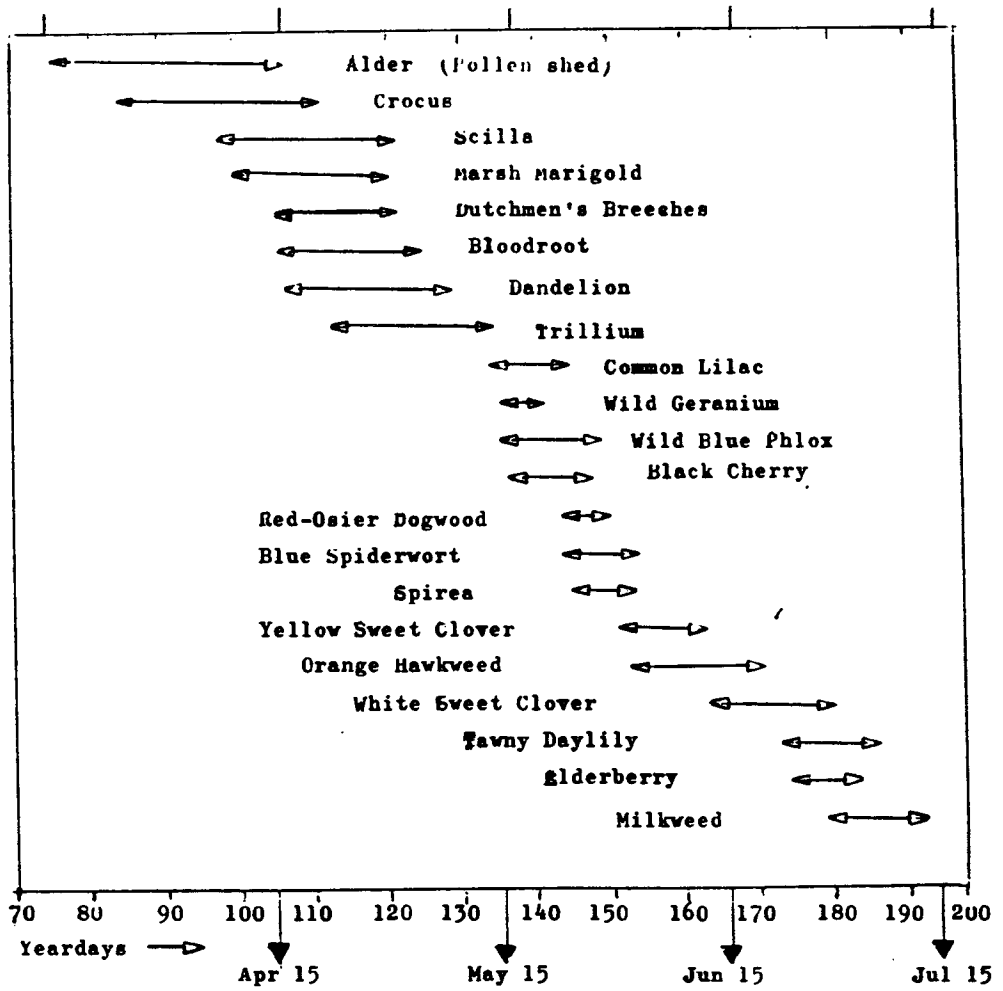
Mrs. Vaughn Brown's home is located in the northeast corner of Washington County in Farmington Township, only a few miles from the Ozaukee and Sheboygan County lines.

Eva Brown characterizes the site as follows: "A combination of Kettle Moraine type hills and plenty of wooded swamp land. Most of my observations are made in my immediate vicinity. I also have a small wild flower garden. The wooded hill on our land contains such trees as red and white cedar, serviceberry, leatherwood, and chokecherry trees and bushes. Along the swamp road are geraniums, marsh marigolds, watercress, cattails; later on in the season Joey Pye weeds and ironwood are abundant. On the flat land close to the North branch of the Milwaukee River we find bloodroot, wild ginger, spring beauty, trout lily, and many more."

Washington County has a continental climate. Prevailing westwinds reduce the influence of Lake Michigan. Winters are relatively long, snowy and cold. Summers are warm; fall and spring show frequently rather abrupt day-to-day weather changes. Temperature variations from year to year and from season to season are considerable. The nearest climatological station of the National Weather Service is located in West Bend. According to the temperature measurements at West Bend the average March temperature for the seven-years period (1970-1976) was 31.2 °F. Extreme departures from this mean value occurred in 1973 (+8.2°) and in 1972 (-3.9 °); only in 1974 did March come close to be "average."

The pollen stage of the alder (*Alnus rugosa*, see 4c1) is an early spring event. According to Eva Brown's observations, its date of occurrence seems to have a good correlation with the monthly mean March temperature.

Supplementary, a semi-graphic version of the Washington County chronology is reproduced below. For the period 1970 to 1976, earliest and latest First Flower dates for 21 selected species are entered in a graph with yeardays as abscissa. The two points are connected by 21 horizontal lines. The method has the advantage to show at a glance that the spread between earliest and latest occurrence tends to decrease with the advance of the season.



b2. Ashland Area

Excerpts from Newsletter of Fall 1977

Dates:	Average	Earliest	Latest
FF, COMMON List			
Crocus	13 Apr	4/06/73	4/17/74
Hepatica	20 Apr	4/08/69	4/28/70
Scilla	25 Apr	4/13/76	5/02/70
March Marigold	2 May	4/24/68	5/09/70
Dutchman's Breeches	5 May	4/22/68	5/10/75
Dandelion	7 May	4/27/76	5/15/72
Bloodroot	8 May	4/29/76	5/17/70
Wild Strawberry	13 May	5/06/69	5/18/70
Trillium (Showy)	16 May	5/06/76	5/23/70
Orange Hawkweed	11 Jun	6/03/75	6/22/68
FF, SPECIAL List			
Trailing Arbutus	23 Apr	4/08/76	5/02/71
False Salomon's Seal	9 Jun	6/05/69	6/20/68
OTHER EVENTS			
Chorus Frog heard	19 Apr	4/10/76	4/25/76
Earthworm castings	21 Apr	4/12/72	5/05/73
Bumble Bee seen	25 Apr	4/12/76	5/12/68
Firefly flashing	16 Jun	6/05/72	6/24/68

The observation site is in Bayfield County, yet so close to the county line near Ashland that the data cannot be considered representative for the Bayfield peninsula. All observations were recorded from 1968-1976 by Mr. & Mrs. Jacob Gilles on their farm in Kelly Township. Jacob Gilles was a charter member of our society from 1959 until his death in 1976.

Mrs. Gilles describes the observation site as follows: "Our farm is located about 7 mi southwest of Lake Superior and 2 mi west of the Ashland county line. The farm is quite level as most of our area although there is a higher ridge northwest of us, about 1/2 mi away. The White River runs about 1/3 of a mile south of our farm. There is a creek, often dry in summer, a short way south of the house, and there are trees and bushes growing along it, so it is handy to watch things grow. We have moved some wildflowers into our yard to enjoy.

In the spring we have often a northeast wind off the lake and it is quite cold, although a few miles south of here there is often a warm wind."

The climate station of the National Weather Service nearest to the observation site is located in Ashland at the Agricultural Experiment Station of the University of Wisconsin Extension Service. The area has a continental climate, modified during all seasons by the proximity of Lake Superior. Chequamegon Bay freezes regularly each winter with the ice usually not going out before the second half of April. Snow blankets the area normally from November to March, and in many years the snow cover keeps the soil completely free of frost. Even in January of 1977 when the southern counties of the state had a frost depth of more than 25 inches, the ground in the Ashland area was frozen only 1-6 inches deep.

Spring is short in the northern counties. The probability of a frost after May 20 is still 80 percent. Summers are warm. In fall, the moderating influence of Lake Superior is felt several miles inland resulting in a somewhat longer growing season. The average length in the Ashland area is 140 days as compared to 100-110 days in north-central Wisconsin (according to Wang and Suomi: "The Phyto-Climate of Wisconsin," Res. Rep. No. 1, Agricultural Experim. St., University of Wis.).

b3. Oneida County Wetland

Excerpted from Newsletter of Spring 1978

Dates:	Average	Earliest	Latest
FF, COMMON List			
Scilla	18 Apr	4/06/73	4/28/72
Hepatica	25 Apr	4/13/63	5/13/67
Bloodroot	1 May	4/21/73	5/16/67
Dutchman's Breeches	2 May	4/24/73	5/13/66
Marsh Marigold	12 May	5/05/63	5/25/67
Trillium (Showy)	16 May	5/09/69	5/26/66
Orange Halkeed	9 Jun	6/01/64	6/17/74
FF, SPECIAL List			
Trailing Arbutus	30 Apr	4/17/63	5/12/61
Swamp Laurel	23 May	5/17/62	6/04/66
Pink Lady's Slipper	30 May	5/23/62	6/13/67
Canada Mayflower	3 Jun	5/28/69	6/14/71

Early in April of 1958, Dorothy and Alonzo Pond came to Lake Shishebogama to make their home on a peninsula. Since that April, the Ponds kept a diary recording plant growth and animal activities that could be observed on the peninsula throughout the year. Noteworthy weather phenomena were also recorded including maxima and minima temperature readings on a window thermometer.

Soon afterwards the Ponds opened their property to the public. Walking over boardwalks and wide trails, visitors got an intimate view of orchids, sundew, pitcher plants and other seldom seen plants of the northern bogs.

Among numerous observations of bird and insect sightings (bumblebees, dragonflies, hatching of mayflies, etc.), the arrival of the first warbler wave was recorded from 1959 to 1965. The most frequent arrival date was May 14 and 15. In 1961, when we had one of the latest springs with night temperatures below freezing in the middle of May, the warblers arrived 14 days late, on May 28, but just two years later, they were present on May 8.

The flowering dates of plants that were reported for at least eight years are listed in the table. Blooming dates of spring flowers vary considerably from year to year, yet the blooming sequence of this native plant community remains rather constant.

b4. University Heights Area in Madison

Excerpted from Newsletter of Fall 1980
(Supplemented with data from 1966 to 1987)

Dates:	Average	Earliest	Latest
FF, COMMON List			
Crocus	10 Mar	2/25/84	3/26/80
Scilla	2 Apr	3/24/68	4/23/75
Hepatica	8 Apr	3/25/76	4/23/75
Bloodroot	17 Apr	4/09/76	4/25/72
Wild Ginger	17 Apr	4/06/81	4/26/72
Dutchman's Breeches	19 Apr	4/11/77	4/29/72
Virginia Bluebell	23 Apr	4/12/68	5/05/79
Wild Strawberry	29 Apr	4/16/76	5/14/75
Trillium (Showy)	2 May	4/19/77	5/12/72
Columbine	16 May	5/02/77	5/20/72
Wild Geranium	16 May	5/03/77	5/23/75
Mayapple	18 May	5/06/77	5/22/72
FF, SPECIAL List			
Snow Drops	17 Mar	2/26/76	4/05/72
Winter Aconite	6 Apr	3/20/76	4/16/80
Vinca	22 Apr	4/10/76	5/01/80
Trout Lily	26 Apr	4/16/76	5/04/79
Canada Violet	28 Apr	4/16/77	5/07/75
Bellwort	28 Apr	4/17/76	5/09/72
Purple Trillium	30 Apr	4/18/77	5/10/75
Prairie Trillium	1 May	4/18/77	5/14/84
Euphoria	1 May	4/12/76	5/13/72
Jack-in-the-Pulpit	5 May	4/21/77	5/15/75
Blue Wood Phlox	7 May	4/23/77	5/18/75
Star of Bethlehem	12 May	4/30/85	5/18/75
Yellow Lady's Slipper	16 May	5/01/77	5/21/72
Shooting Star	18 May	5/04/77	5/26/66
True Solomon's Seal	3 Jun	5/19/77	6/15/83
Turk's Cap Lily	6 Jul	6/27/87	7/15/83
Autumn Crocus	2 Sep	8/26/77	9/15/83

Annual flowering dates from 1971-80 are listed for seven species. Positive numbers indicate days after March 31, negative ones days before March 31; leap years are treated like other years. A statistical measure of the range of delays in some years and advancements in others are the standard deviations listed for this decade in the last column.

	1971	72	73	74	75	76	77	78	79	80	Averages
Hepatica	10	17	-5	13	23	-6	-2	12	14	17	9.5 ± 9.6
Bloodroot	13	25	20	18	23	9	10	12	22	20	17.2 ± 5.5
Wild Ginger	20	26	15	23	26	10	13	14	22	20	18.3 ± 5.3
Dutchman's Breeches	17	29	19	21	26	13	11	22	24	21	20.3 ± 5.3
Showy Trillium	35	42	31	31	40	26	19	37	35	33	32.9 ± 6.4
Lady's Slipper	49	51	48	50	48	44	31	49	46	49	46.5 ± 5.5
Shooting Star	49	50	46	50	52	48	34	54	51	52	48.6 ± 5.3

The University Heights Area chronology was supplemented in the 1992 Newsletter by 10-year mean wildflower blooming dates for two decades. The listings show that 1971-1980 the blooming dates were on the average 3 days earlier in April, and 2 days earlier in May, than 1981-1990.

Species	**Dates of First Flower**		
	1971-1980	**1981-1990**	**Difference**
Hepatica	10 April	08 April	2 days
Bloodroot	17	12	5
Dutchman's Breeches	20	17	3
Canadian Violet	26	22	4
Virginia Bluebell	26	25	1
Bellwort	29	26	3
Large White Trillium	03 May	01 May	2
Jack-in-the-Pulpit	05	05	0
Yellow Lady's Slipper	17	13	4
Wild Geranium	17	14	3

A summary of monthly mean temperatures below (courtesy of Pam Naber, state climatologist) includes the months from January through May. The temperature differences for April and May are small and hardly significant. However, January through March 1971-1980 show consistently relatively high temperatures. Disregarding other factors like snowcover and accumulated degree days, it seems that relative warmth in January through March contributes to relative earliness of April and May flowers.

Month	January	February	March	April	May
1981-1990	14.2	19.3	32.6	45.7	58.0
1971-1980	18.9	22.9	34.3	47.1	57.4
Difference	+4.7	+3.6	+1.7	+1.4	-0.6

The phenological chronology of wildflower blooming dates is based on records of "First Flowers Open" observed in the front- and backyard of my home in the University Heights area of the city. This hilly region, shaded by many old trees, is located adjacent to the west of the University of Wisconsin campus. It is an older residential section with large houses on relatively small lots. The observation site is very shady during the summer, but most of the wildflowers come into bloom before the leaves of the 80- to 90-year-old oak trees are fully developed. The lot slopes slightly to the northwest. The topsoil is a thick layer of oakleaf mulch over yellow moraine sand. All the wildflowers growing at the site were transplanted around 1925 and after, by the first owner of the home.

Included in the special listing are snowdrops (*Galanthus nivalis*) and winter aconite (*Eranthis hyemalis*). Although not native wildflowers, these are among my favorites because they are the first harbingers of spring after our long Wisconsin winters. As could be expected, they show the longest time span between early and late flowering. Phenologically, the two earliest years of the decade were 1976 and '77, the latest 1972 and '75.

Additional phenological recordings from the same neighborhood can be found on page 6 of our "Recording Diary."

b5. Outagamie County

Excerpted from Newsletter of Fall 1983

Dates:	Average	Earliest	Latest
FF, COMMON List			
Scilla	15 Apr	4/04/68	4/26/72
Bloodroot	20 Apr	4/13/81	4/26/82
Marsh Marigold	24 Apr	4/05/80	5/05/82
Milkweed	3 Jul	6/24/80	7/10/74
OTHER EVENTS			
Frost out of ground	6 Apr	3/10/73	4/18/80
Earthworm castings seen	12 Apr	3/26/76	4/20/79
Bumble Bee seen	28 Apr	3/28/76	5/12/72
Mosquitoes biting	6 May	4/10/77	5/20/73
Firefly flashing	7 Jun	5/05/71	6/27/82

Eleanor Brenneke began reporting phenological events in 1965 and, assisted by her family, has continued ever since to contribute valuable information from Hortonville.

Hortonville is situated in the southwest section of Outagamie County, about halfway between Appleton and New London. This part of Wisconsin is mostly gently rolling and flat farmland with swampy areas along the rivers. The climate is continental with cold winters and warm summers; spring and fall are sometimes short. The soils are reddish and grayish-brown clays and loams. The U.S. Weather Service maintains climatological stations in Appleton and New London recording temperature and precipitation. The Brennekes have their own thermograph and rain gauge in their garden.

Eleanor Brenneke writes: "Our property is about 2 acres and slopes to a creek to the north. The elevation of Black Otter Creek is given as 770 ft. on geological maps, our house is about 785 ft. Most of the observations are made in our own yard, a few are from a location just north and west of Hortonville, of the canning company's waste water lagoons. That is about 3/4 of a mile from our house."

b6. Langlade County

Excerpted from Newsletter of Fall 1985

Dates:	Average	Earliest	Latest
FF, COMMON List			
Hepatica	17 Apr	4/05/81	4/22/82
Bloodroot	24 Apr	4/15/81	5/03/75
Dutchman's Breeches	27 Apr	4/23/81	5/01/82
Dandelion	4 May	4/29/76	5/14/79
Marsh Marigold	7 May	5/01/76	5/14/79
Trillium (Showy)	9 May	5/01/74	5/15/79
Yellow Rocket	16 May	5/01/77	5/29/78
Colombine	3 Jun	5/29/80	6/09/74
Orange Hawkweed	9 Jun	5/25/77	6/25/83
Milkweed	3 Jul	6/25/80	7/11/83
FF, SPECIAL list			
Spring Beauty	22 Apr	4/10/81	4/25/82
Trout Lily	5 May	4/30/81	5/11/75
Yarrow	17 Jun	5/31/77	6/25/80
Fireweed	2 Jul	6/25/77	7/11/83
Goldenrod	22 Jul	7/11/83	7/30/75
OTHER EVENTS			
Chorus Frog heard	17 Apr	4/12/80	4/27/78
Bumble Bee seen	7 May	4/22/80	5/20/77
Monthly temperature (Antigo, WI)			
March	26.8	21.8/75	35.2/77
April	42.2	46.5/75	48.5/77
May	54.5	48.1/83	63.4/77
June	62.2	56.9/82	66.6/76

Langlade County has a continental climate characterized by cold, snowy winters, warm summer days and cool summer nights. The transition from summer to winter and from winter to summer is quite often abrupt. Spring temperatures vary greatly from year to year as shown by the values listed for Antigo. Between 1974 and 1984 the differences between lowest and highest monthly mean temperatures were 13.4° for March, 12 ° for April, 15.3 ° for May, and 9.7 ° for June. During this decade the coldest spring occurred in 1975 and the warmest two years later. Accordingly, phenological events were two to three weeks earlier in 1977 than in 1975.

The seasonal distribution of precipitation is well suited to agriculture. About 70 percent of the annual amount falls from May through September. There is still a 10 percent change for temperatures below 32° during the first week of June; also a 10 percent chance of frost on the first of September.

For climatological averages ten years are hardly a sufficient period because monthly temperatures vary so greatly, especially in spring. The 30-year averages are more representative for long-term trends. The observations at the climatological station of the U.S. Weather Service in Antigo indicate that the annual mean temperature declined by one degree from 1930 to 1980. Overlapping 30-year averages for individual months show that this is primarily due to colder winters and somewhat cooler summers; spring and fall temperatures show less change.

Overlapping 30-Years Monthly Temperatures for Antigo, WI as published by the National Climatic Data Center in Asheville, N.C. 28801-2696.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1930-59	15.6	17.4	27.1	42.6	55.2	64.6	69.1	67.2	58.7	47.8	31.9	20.0	43.1
1941-70	13.9	16.8	27.1	43.1	54.6	63.8	68.0	66.4	57.7	48.3	32.0	15.4	42.6
1951-80	11.9	16.1	26.9	42.7	54.9	63.5	68.0	65.9	57.3	47.4	31.9	18.2	42.1

b7. Waupaca County

Excerpts from Newsletter of Spring 1986

Dates:	Average	Earliest	Latest
FF, COMMON List			
Marsh Marigold	4 May	5/22/77	5/14/75
Trillium (Showy)	10 May	4/30/85	5/18/79
Yellow Rocket	13 May	5/05/81	5/22/82
Virginia Bluebell	16 May	5/04/77	5/26/83
Wild Geranium	25 May	5/14/85	6/07/83
Colombine	1 Jun	5/23/77	6/09/79
Orange Hawkweed	13 Jun	6/01/85	6/27/75
Milkweed	8 Jul	6/28/77	7/15/79
FF, Special List			
May Apple	20 May	5/13/77	5/30/81
Yellow Lady's Slipper	27 May	5/15/85	6/02/81
Oxeye Daisy	1 Jun	5/25/77	6/12/83
True Salomon's Seal	15 Jun	6/01/77	6/23/83
Blue Spiderwort	22 Jun	6/09/77	7/08/82
Tawny Daylily	5 Jul	6/28/77	7/15/79
Turk's Cap Lily	12 Jul	7/04/77	7/22/79
OTHER EVENTS			
Frost out of ground	4 Apr	3/12/77	4/20/79
Earthworm castings seen	14 Apr	3/27/84	4/22/78
Mosquito Biting	5 May	4/04/81	5/18/83

Lillie Ann Rasmussen writes: We live on a farm about one and a half miles from the small town of Scandinavia and ten miles north of the famous Waupaca Chain-of-Lakes. This country is very hilly with lots of stones, some of them huge boulders. The region was settled mostly by Norwegians, as the hills reminded them of home.

Besides hills and stones, we have ten acres of open marsh with a small creek running through it. The creek gets very low in dry summers but is never completely without flow as it is spring-fed. It empties into the South Branch of the Little Wolf River about a mile away. In the marsh grow Marigolds, Pussy Willows, Marsh Milkweeds, Boneset, and Joe-Pye-Weed. A few plants of Purple Loosestrife on the creek banks do not seem to be spreading. Along the edge of the marsh we have the Meadow Rues, a few Purple-Fringed Orchids (*Habenaria psycodes*) and Turk's Cap Lilies.

We also own about 20 acres of upland woods. Along with common woodland plants I found the lovely Yellow Lady's Slipper (*Cyripedium pubescens*) and the rare Adam and Eve (*Aplectrum hyemale*) orchids. We also have Rattlesnake Plantain (*Goodyear pubescens*) and the Spotted Coral Root (*Corallorhiza maculata*). In Trillium time the woods are carpeted with white.

Part of my large garden is on a sandy knoll. I have grown several wildflowers from seeds that are indigenous to dry sandy areas. As permanent residents I have Butterfly Weed (*Asclepias tuberosa*), Pasque Flowers (*Anemone patens*) and a couple of Yucca plants.

About the Climate: Scandinavia lies in the west-central section of Waupaca County, about 6 miles east of the Portage County boundary. The nearest observing station of the U.S. Weather Service is in the city of Waupaca, about 10 miles south of Scandinavia. The elevation difference between Waupaca (840 ft.) and Scandinavia (960 ft.) will have less influence on the occurrence of phenological events than microclimatic variability in this hilly country.

Waupaca County's continental climate has warm summers and cold winters with moderate snowfall. The transition from summer to winter can be rather abrupt. The snowfall of early November 1985 confirms this, as November was also colder than normal and, followed by the second snowiest December on record, an unusually heavy snow cover remained on the ground ever since that first snowfall. Consequently, the frost depth of the 1985/86 winter is remarkably low in most of Wisconsin.

Spring weather varies greatly from year to year, as documented by the departures from normal temperatures from 1975 to 1984. In 1975, March and April were extremely cold, in sharp contrast to 1977 when they were unusually warm. Earliness or lateness of phenological events during May depends to a large degree on the anomalies of the thermal characteristics of March and April. The records from Scandinavia show that in 1975 the "First Flower" events were retarded through the entire month of May. In 1977 all events were advanced even though June was cold, with the help of a very warm May.

30-years (1941-70) Normal Temperatures at Waupaca, WI, and Departures from Normals for 1975 to 1984 during the growing season.

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Normal Temp. °F
March	-2.9	4.1	9.1	-1.6	-0.2	-2.6	5.3	-0.8	3.2	-4.3	29.8
April	-5.2	3.7	4.8	-3.4	-3.5	1.1	2.0	-4.2	-3.5	1.8	45.6
May	5.2	-1.1	8.0	1.2	-3.6	2.7	-1.8	4.6	-6.3	-3.6	57.1
June	0.5	3.0	-2.2	-1.4	-1.8	-1.7	-0.1	-6.1	-0.2	1.4	66.6
July	1.5	2.1	2.9	-2.8	-0.3	1.2	-0.8	0.3	3.5	-1.8	70.0
August	0.7	0.4	-3.4	0.2	-3.0	0.1	0.0	-2.8	3.9	1.8	69.3
September	-3.8	0.2	0.5	3.2	1.4	-0.8	-2.0	-2.3	0.6	-1.6	60.3

b8. Brown County

Excerpted from Newsletter of Spring 1987

Dates:	Average	Earliest	Latest
FF, COMMON List			
Crocus	6 Apr	3/21/73	4/27/85
Scilla	11 Apr	4/02/76	4/25/72
Bloodroot	26 Apr	4/11/81	5/11/78
Marsh Marigold	27 Apr	4/18/76	5/06/72
Yellow Rocket	4 May	4/25/85	5/08/84
Trillium (Showy)	8 May	4/28/76	5/14/72
FF, SPECIAL List			
Canada Thistle	28 Jun	6/09/83	7/14/68
OTHER EVENTS			
Bumble Bee seen	25 Apr	4/09/81	5/10/78
Mosquito bite	15 May	5/01/85	5/28/68

Observed are the average dates for four phenological phases of one common purple lilac bush at DePere, Brown County, during 1969 to 1985. The bush is located 4 ft away from a building and exposed to South-East; its height was 12 ft in 1974.

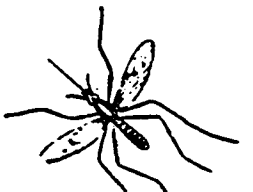
	Average	Earliest	Latest
First Leaf Buds out	26 Apr	4/14/76	5/08/83
First Flowers open	15 May	5/03/77	5/22/83
Peak Bloom	22 May	5/08/77	6/01/83
95% Flowers withered	2 Jun	5/20/85	6/10/83

Brown County is part of the east-central section of Wisconsin. DePere lies about five miles south of Green Bay at an altitude of 600 ft, about 100 ft above the Fox River lowlands. The nearness of the Green Bay and Lake Michigan, also the Niagara limestone ridges rising to the east, are topographical features that moderate the temperature range between summer and winter. This can be documented if, for example, one compares the long-term monthly mean temperatures from climate stations in Green Bay with those from Eau Claire which is located at about the same latitude in the west-central section of the state. Green Bay is 3-4° F milder in winter and 1-2° F cooler in summer than Eau Claire.

It is unusual that an entire spring season in Wisconsin can be called "normal." Yet it happened in 1969. After a record breaking snowfall in December '68 and January '69, the snow melted slowly with a good recharge of soil moisture due to little frost in the ground. Temperatures averaged close to normals during the winter and spring seasons.

By lucky coincidence it happened that in 1969 Mr. Cleary reported an extraordinarily large number of events in comparison with any year of his 20 years of observing and recording. A "supplementary" Brown County chronology for the year 1969 is reproduced below. Forty-three events are sequentially grouped from March through August. Multi-annual mean dates for eleven events are added in parantheses. Comparisons show that the 1969 dates agree very closely with the averages.

```
Chipmunk seen            19 --------- MARCH
Pussywillows FP          20
Sugar Maple Sap running  24 (18)

   Gopher seen                04 --------- APRIL
   Yellow Crocus FF            06  (06)
   Frost out of ground         07
   Chorus Frog heard ----------09
   Scilla sibirica FF           11  (11)
   Earthworm castings           18
   Am.Elm stamen full length    18
   Suckers running              19
   Red Maple FF                 19
   White Birch FP               20
   Trailing Arbutus FF ------------ 22
   Wild Plum FF                   24
   Bumblebee seen                  25  (25)
   Dandelion FF                    26
   Marsh Marigold FF               26  (27)
   Bloodroot FF                     27   (26)
   Cottonwood FP                     29

         Large White Trillium FF          05 (08)--- May
         Yellow Rocket FF                  06   (04)
         Common Lilac FF                    10    (15)
         Wild Geranium FF                   14
         Mosquito biting ------------------ 14     (15)
         Wood's Blue Phlox                  18
         Wild Strawberry FF                 18
         Lily-of-the-Valley FF               25
         Bridal Wreath FF                     28  (27)

               Wild Rose FF                        06 --- JUNE
               Yellow Sweet Clover FF               30
               White Sweet Clover  FF               30

                        Canada Thistle FF                01 ---- July

                              Cicada heard                   06 ----- August
```



b9. Western Racine County

Excerpts from Newsletter of Fall 1987

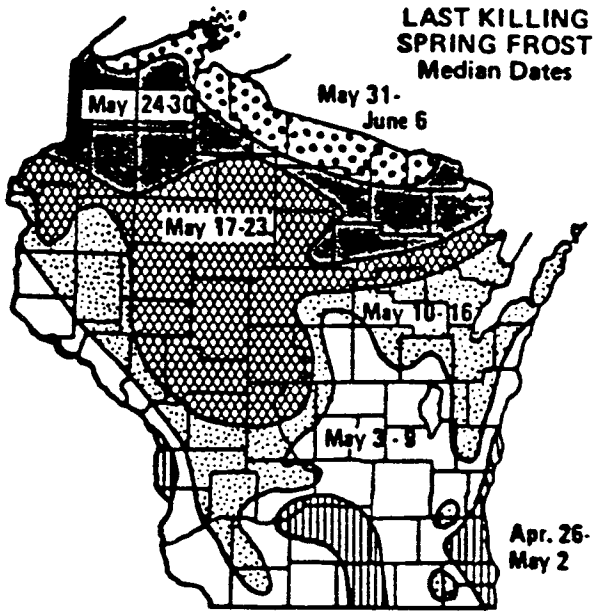
Dates:	Average	Earliest	Latest
FF, COMMON List			
Crocus	28 Mar	3/09/85	4/12/80
Hepatica	7 Apr	3/24/87	4/17/84
Scilla	13 Apr	4/01/86	4/21/79
Bloodroot	15 Apr	4/02/86	4/25/84
Dutchman's Breeches	19 Apr	4/06/81	4/25/83
Dandelion	25 Apr	4/12/81	5/04/80
Virginia Bluebell	30 Apr	4/19/85	5/11/78
Trillium (Showy)	5 May	4/25/85	5/16/78
Yellow Rocket	5 May	4/23/81	5/14/83
Wild Geranium	15 May	5/03/85	5/24/84
Columbine	17 May	5/03/85	5/24/84
FF, SPECIAL List			
Toothwort	18 Apr	4/08/86	4/26/84
Woods Blue Phlox	1 May	4/19/81	5/09/78
Bellwort	2 May	4/25/85	5/09/84
Jacob's Ladder	2 May	4/18/81	5/11/78
Shooting Star	15 May	5/05/85	5/23/84
Mayapple	18 May	4/25/85	5/29/83
Yellow Starflower	18 May	5/09/85	5/24/84
Blue Spiderwort	10 Jun	5/25/85	6/20/83
OTHER EVENTS			
Chorus Frog heard	29 Mar	3/06/83	4/17/87
Bumble Bee seen	29 Apr	4/17/85	5/16/78
Mosquito Bite	5 May	4/09/81	5/23/83
Firefly flashing	16 Jun	6/09/81	6/27/82

Kathleen Ela writes: we live in an area of moraine hills, about 5/8 mile west of the village of Rochester, which is five miles northeast of Burlington, in western Racine County, about 3/4 mile west of the lower Fox River, and 23 miles west of Lake Michigan, as the crow flies. Between us and the village are remnants of once extensive marshes. Two of these (both under about two acres of water, most years) are on our land. Rather steep hills and kettles, now wooded, come down almost to the house and barn, on the north. To the south, east and west, and across the road, are orchards.

In the woods are oak, basswood, maple, hickory, walnut, with some butternut, poplar, mulberry, but tending toward maple as they evolve. Originally, I believe, this land may have been open prairie, with "oak openings." Prairie plants are still found, wherever there are openings, or where there has been enough grazing to keep out tree seedlings. About 10 acres just north of the house have not been grazed for 70 years and are now thickly wooded, as are another 50 acres now under "forest management." These 50 acres include an upland, with needle grass, Baptisia, black-eyed Susan, spotted knapweed, vervain, bird-foot violets, St. Johnswort, etc., that indicate a former prairie. We also found ladies' tresses orchids there, and little bluestem flourishing in what has been a sheep pasture, not now being grazed heavily. However, where grazing has diminished, hepaticas, yellow stargrass and violets are having a harder time competing with grasses. Trilliums and Jack-in-the Pulpit grow in the kettles, and bloodroot and yellow violets on higher ground, toothwort sometimes covering one whole side of a kettle. A "seep" that leads into the marsh provides habitats for marsh marigolds and, in some years, cardinal flowers. Wild iris, mint, water willow (among other things) and turtlehead grow in one marsh, and giant lobelia and swamp milkweed in another. The Honey Creek Wildlife area is about a mile or a little less to the south of us, and we have found showy orchids there. I have heard about gentians in that marsh, but I have not seen any. I once observed and made a list of 126 flowering plant species, but I don't think I came near to listing all that exist here.

Soils in our orchards are mostly sandy loam over red clay, rocky or gravelly on hills. There are six gravel pits in this township – we are a pocket of resistance to gravel and housing development! Bloom times seem about a week behind those of Madison. There is some difference between here and Racine, though I don't go there often enough to keep track of it. We are shelterd by hills and woods, and do not have quite the extreme temperatures or winds that one might find east of Rochester where the land is flatter and less wooded.

Kathleen Ela's observations are representative for western Racine County. In her commentaries, she refers to differences with the county's eastern region along the shore of Lake Michigan. It is well known that phenological spring and early summer events usually occur later along the lakeshore than farther inland. However, the last killing spring frost can be expected between April 26 and May 2 in the eastern region but as late as May 10 to 16 in the southwestern corner of the county. This new detailed map was developed by State Climatologist Douglas Clark (a member of the Society) using data from 1951 to 1980 from 72 weather reporting stations.



c: Chronologies for Trees & Shrubs, Mushrooms, and Event Variability

c1. Tree & shrub data for seven of the stations listed in Chapter 4b

Katharina Lettau, Madison; 1992

Dates:	Average	Earliest	Latest
WASHINGTON COUNTY (1970 - 1976)			
Alder (pollen shed)	5 Apr	3/23/76	5/17/73
Wild Black Cherry (FF)	22 May	5/17/76	5/29/73
Red Osier Dogwood (FF)	28 May	5/25/76	5/31/71
Black Elderberry (FF)	28 Jun	6/20/70	7/03/71
ASHLAND AREA (1968 - 1976)			
Sugar Maple (sap running)	23 Mar	3/11/73	4/04/69
Alder (first pollen)	13 Apr	3/27/73	4/29/75
Hazelnut (first pollen)	22 Apr	4/15/68	5/07/75
Quaking Aspen (first pollen)	22 Apr	4/08/76	5/04/72
Pussy Willow (first pollen)	22 Apr	4/08/76	5/06/75
Am. Elm (stamen full length)	27 Apr	4/13/76	5/11/72
White Birch (first pollen)	9 May	4/11/76	5/10/72
Wild Plum (FF)	12 May	5/06/68	5/20/72
White Pine (shoots 2" long)	21 May	4/30/76	5/31/71
White Pine (first pollen)	17 Jun	5/20/76	6/27/71
ONEIDA COUNTY Wetland (1959 - 1974)			
Pussy Willow (first pollen)	20 Apr	4/05/62	4/29/66
Red Maple (FF)	29 Apr	4/15/68	5/11/72
White Pine (shoots 2" long)	29 May	4/22/69	6/08/71
Wild Rose (FF)	16 Jun	6/09/64	6/23/60
OUTAGAMIE COUNTY (1971 - 1980)			
Am. Elm (stamen full length)	20 Apr	4/10/72	4/30/78
White Birch (first pollen)	29 Apr	4/14/77	5/07/75
Spirea (FF)	24 May	5/11/77	6/01/79

(continued)

LANGLADE COUNTY 1974 - 1981)			
Sugar Maple (sap running)	14 Mar	2/25/81	3/20/77
Quaking Aspen (first pollen)	18 Apr	4/05/81	4/26/74
Hazelnut (first pollen)	20 Apr	4/05/81	5/04/79
Alder (first pollen)	22 Apr	4/06/81	5/04/79
Pussy Willow (first pollen)	25 Apr	4/11/81	5/04/79
Wild Plum (FF)	13 May	4/30/77	5/30/76

WAUPACA COUNTY (1975 - 1985)			
Sugar Maple (sap running)	17 Mar	3/07/85	3/28/80
Alder (shedding pollen)	8 Apr	3/25/77	4/21/83
Pussy Willow (first pollen)	17 Apr	3/23/79	5/08/75
Wild Plum (FF)	8 May	4/22/77	5/20/83
Wild Black Cherry (FF)	20 May	5/04/77	5/29/76
Red Osier Dogwood (FF)	29 May	5/10/85	6/13/83
Black Locust (FF)	4 Jun	5/20/77	6/18/83
Gray Dogwood (FF)	17 Jun	5/21/77	6/25/81
Black Elderberry (FF)	29 Jun	6/20/77	7/06/83

c2. Mushroom Plicking in Marinette County
Henry Herreid, Wausakee; 1983

First Plicking Dates:	Mean	Earliest	Latest
Morels	4 May	4/20/76	5/12/78
Parasols	17 Aug	8/08/77	8/26/78
Giant Puffballs	5 Sep	8/29/78	9/09/80
"Honey" Mushrooms	9 Sep	8/31/77	10/03/78

The observations were made in the township of Wausaukee. Marinette County is in the north-east district of Wisconsin. Mr. Herreid has a wide variety of trees on his property – elm, hard and soft maple, white, Jack and Norway pine, red and black oak, cherry, butternut, ash, Ironwood, poplar, birch, etc. Some of the land is made up of sand hills and some is flood plain.

c3. Statewide variability of six spring events

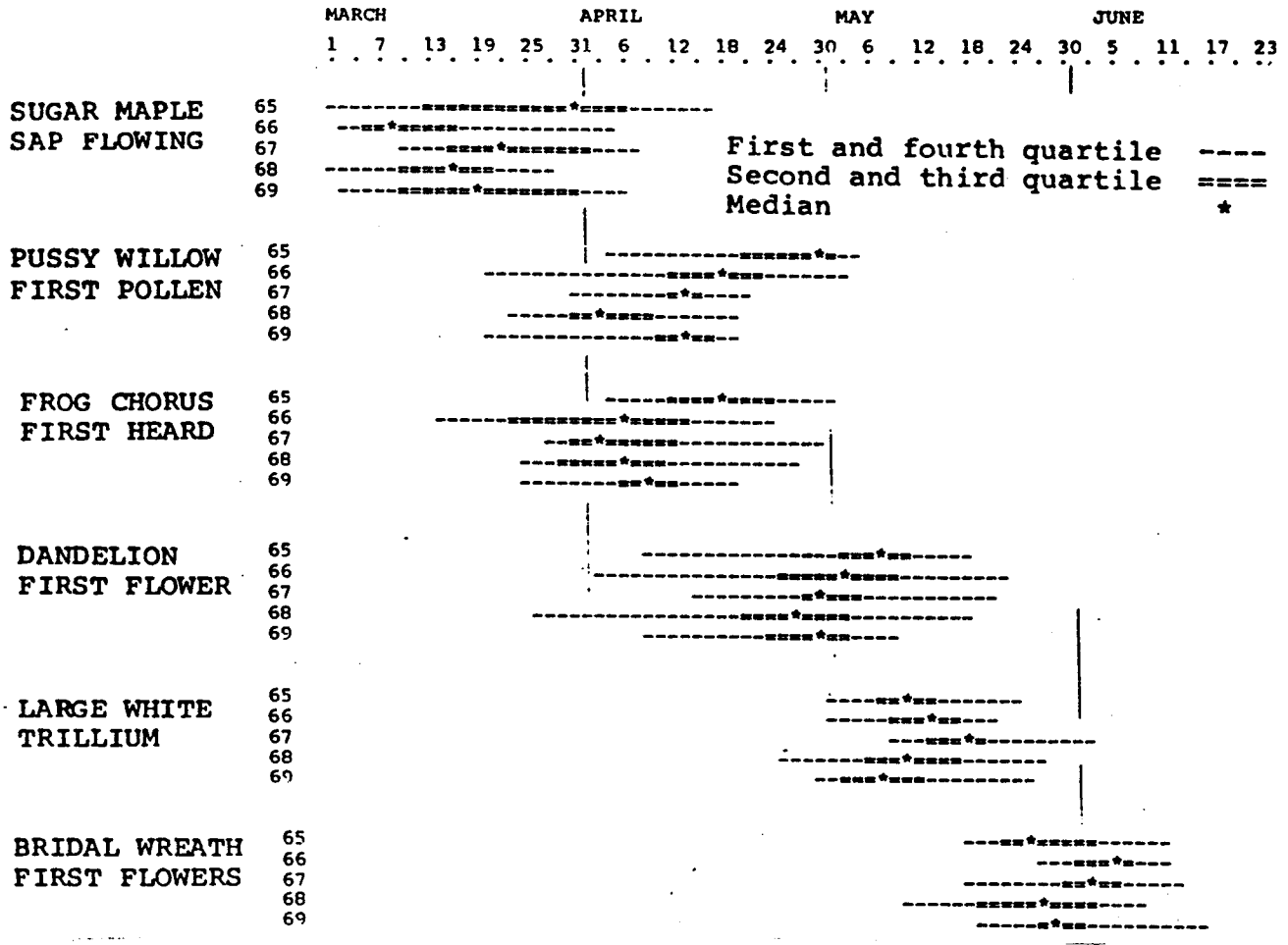
Katharina Lettau, Madison; 1969

The semi-graphic version of a chronology has been designed to show the statewide variability in the occurrence of six most frequently reported spring events. Used are data from the five years 1965 to 1969. Each year summarizes 20 to 40 reports from our observers across the entire state. The reports are grouped statistically according to "quartiles" and a "median" date. A "quartile" marks the time interval during which one quarter of the total number of observations is reported. Thus, the length of the first quartile indicates the number of days it took to reach 25 percent of all observations; a long quartile implies a slow or interrupted development, a short quartile means a concentrated rush of occurrences.

Compare, for example, sugar maple sap flowing in different years. In 1965, the event began early in March (which appears to be normal) but progressed very slowly during the second half of March. It took 31 days to pass the 50 percent mark, that is the median number of observations. However, in 1966, sap flowing began suddenly and within a week the median number was reached.

Another illustrative example is the flowering of dandelions. The long drawn-out first quartile each year implies that a few flowers appear unusually early each year, probably in sheltered spots such as near south-facing walls.

The diagram also demonstrates that later spring events have shorter quartiles than early spring events. That means, they are less likely to be affected by cold spells which may produce a slow-down but not a standstill of the development.



5 PHENOLOGY OF LAKE EVENTS

a: Lake Freeze and Icecover Duration

1. **Ice on Wisconsin lakes**
Katharina Lettau, Madison; 1981 66

2. **Ice chronology for the three Madison lakes, Dane County**
Douglas Clark, Madison; 1981 69

3. **Ice chronology for Otter Lake, Outagamie County**
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b: Lake Fauna and Flora

1. **Frog Call Chronologies - Dane County and Statewide Summary**
Maarit Threlfall, Madison; 1982, and
Katharina Lettau, Madison; 1980 71

2. **A Phenologic Study of Aquatic Invertebrates (Condensed)**
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3. **Water Lily Chronology - Oneida County and Ashland Area**
Dorothy & Alonzo Pond, Minocqua; 1978, and
Mr. & Mrs. James Gilles, Kelly Township; 1978 73

a: Lake Freeze and Icecover Duration

a1. Ice on Wisconsin Lakes

Katharina Lettau, Madison, 1981

Wisconsin has more than 4000 named lakes and more than 4000 unnamed ponds. At least one lake is found in each county; Vilas with 524 has the most.

The average size of the named lakes is 213 acres, of the unnamed ponds 6.9 acres. Lakes cover 2.6 percent of the state's area. Because Wisconsin winters are long and hard, all lakes freeze quite regularly in November or December and remain ice-covered for three to five months. Both formation and disappearance of ice can be considered a phenological event because it is a natural periodic phenomenon related to weather and climate just as is the seasonality of plants and animals. Even though the growth of ice crystals is not strictly "bioclimatic," it has biological significance to organisms in the lake and is influenced by climatic elements such as temperature, precipitation, wind and radiation which are subject to seasonal change.

In summer, lakes store heat efficiently due to the heat capacity of water and the mixing action of wind-generated waves and currents. In fall, land temperature decreases more rapidly than that of water, and heat is released into air from the lakes. The length of this cooling period before ice forms depends to a large degree on the dimensions of the lake and additional factors like inflow, underwater springs, currents and possibly discharge from factories and heating plants. Thus, under the same weather conditions neighboring lakes may freeze at different times.

The duration of ice-cover and ice thickness are of special interest to ice fishing and ice boating, also to lumber and fishery industries. During the 20-years from 1950 to 1970, lakes in the northern counties were ice-covered between 140 and 150 days, and in the southern counties between 100 and 120 days on the average. Year-to-year variations can be considerable. Lake Mendota, for example, was frozen only 65 days in the winter of 1965/66, but 126 days in 1958/59.

Members of the Wisconsin Phenological Society who live near lakes began to report freezing and opening dates in 1962. Summarized on the next page are data which were reported without interruption for 10 years since the winter of 1962-63. The 20-year averages were begun in 1950-51. Note that on lakes where both 10- and 20-year averages are listed, duration of ice cover varies only by one to three days.

10-Year Averages 1962-1972

Lake	Distr.	County	Acres	Froze	Opened	Ice Days	Observer
Mendota*	SC	Dane	9730	Dec 24	Apr 6	103	--
Upper Trout	NC	Vilas	3870	Dec 8	Apr 26	139	P. Brenner
Nebagamon	NW	Douglas	997	Dec 1	Apr 19	139	F. Wahlquist
Big Cedar	SE	Washington	942	Dec 19	Apr 10	112	Mrs. J. Schultz D. Schuck
Big	NC	Oneida	792	Nov 18	Apr 19	152	O. P. Richmond
Shishebogama	NC	Oneida	697	Nov 26	Apr 14	139	A. Pond
Little	EC	Door		Nov 25	Apr 13	139	A. Freitag
Sand	NE	Marinette	20	Nov 28	Apr 13	136	J. Saeman
Boot	NW	Washburn		Nov 22	Apr 15	144	R. Bailey
Phantom	NW	Burnett		Nov 24	Apr 15	142	N. Stone

20-Year Averages 1950-1970

Mendota*	SC	Dane	9730	Dec 22	Apr 5	104	--
Lower Mill	SE	Walworth	5330	Dec 11	Mar 28	107	C. Squires
Upper Trout*	NC	Vilas	3870	Dec 8	Apr 27	140	--
Nebagamon*	NW	Douglas	997	Nov 29	Apr 20	142	--
Big*	NC	Oneida	792	Nov 19	Apr 21	153	--
Crooked	EC	Sheboygan	74	Nov 29	Apr 6	128	F. Ramer

* From R. Ragotzkie's "Compilation of Freezing and Thawing Dates for Lakes in North Central United States and Canada" (Technical Report No. 3, Dept. of Meterology, UW-Madison 1970).

In spring, at the time when early flowers are in bloom, Wisconsin lakes are still closed. Yet changes are noticeable in the structure of the ice. The crystals which had formed a strong sheet by interlocking horizontally, grow large and recrystallize into a columnar structure. With incoming radiation increasing rapidly during March the ice begins to melt near the shore and along the boundaries of the columns. Melt water fills the cracks and the ice begins to look dark. When melt water drains from the cracks, air enters and the ice looks white again. This color change may occur within a very short time. In calm weather a lake may stay partly open for many days whereas a storm at this particular time may remove the ice all at once.

Long records of freeze and opening dates are available for several Wisconsin lakes, including Lake Geneva, Shell Lake, Rock Lake, and others. The longest series exists for Lake Mendota in Dane County. Overlapping 30-year averages of ice duration (source: Ragotzkie, 1970) on Lake Mendota, 1855 to 1985 are listed below for the mid-year of each of the eleven 30-year periods. For a chronology for the three Madison lakes see 5a2.

Mid-year:	1870	1880	1890	1900	1910	1920	1930	1940	1950	1960	1970
Days:	122	117	108	107	103	101	102	100	101	106	106

The number of days of ice cover shows a trend that agrees with independent observations on the relative severity of winters. There were long cold ones in the mid-1850s followed by a gradual warming which culminated in the 1940s.

The occurrence of one phenological event is sometimes used as a "predictor" for another that normally occurs somewhat later in the season. For example, it has been found that the year-to-year fluctuations of the opening date of Lake Mendota occurs on the average two days after the pasque flowers on a hill in Middleton come into bloom; see Section 6.

a2. Ice chronology for the three Madison lakes, Dane County

Douglas Clark, Madison; 1981

Records for the three lakes in or near the city of Madison are collected and available at the office of the state climatologist. An abbreviated version of a contribution by Douglas Clark to the 1981 WPS Newsletter follows.

Dates of:	Mean	Earliest	Latest
FREEZING			
Mendota	20 Dec	11/23/1880	1/30/1932
Monona	15 Dec	11/23/1857	1/30/1932
Wingra	27 Nov	11/02/1913	12/29/1877
OPENING			
Mendota	5 Apr	3/08/1983	5/06/1857
Monona	1 Apr	3/06/1983	5/04/1857
Wingra	30 Mar	3/02/1882	4/29/1881

Duration (days):	Average	Shortest	Longest
ICE COVER			
Mendota	106	55:1982/83	161:1880/81
Monona	113	56:1982/83	160:1880/81
Wingra	121	70:1877/87	164:1880/81

a3. Ice chronology for Otter Lake, Outagamie County
The Brennekes, Hortonville; 1983

Otter Lake, with a greatest depth of 16 feet, lies in a valley with hills surrounding it for about a mile in each direction. It is drained, at an elevation of 770 feet, by the Black Otter Creek into the Wolf River. Summarized are records for the ten winters from 1962/63 to 1972/73.

Dates of:	Mean	Earliest	Latest
FREEZING	25 Nov	11/15/1972	12/01/1966
OPENING	8 Apr	3/25/1973	4/25/1972
Duration (days):	**Average**	**Shortest**	**Longest**
ICE COVER	135	124:1966/67	150:1971/72

The average duration of 135 days agrees reasonably well with records from the two lakes in the east-central district of Wisconsin listed in Section 5.1: 139 days for Little Lake in Door County and 128 days for Crooked Lake in Sheboygan County.

b: Lake Fauna and Flora

b1. Frog Call Chronologies - Dane County and Statewide Summary

Maarit Threlfall, Madison; 1982, and
Katharina Lettau, Madison; 1980

South Central Wisconsin - Dane County

This chronology is extracted from Maarit Threlfall's listings in the Spring 1982 Newsletter. First frog calls and toad trillings had been reported from various places around Madison (mostly at the UW Arboretum and Cherokee Marsh), by various watchers, and during various periods.

Dates of:	Mean	Earliest	Latest
FIRST CALL			
Chorus Frog	30 Mar	3/13/73	4/15/75
Leopard Frog	7 Apr	3/21/72	4/25/79
Tree Frog	11 May	5/09/81	5/18/72
Green Frog	17 Jun	6/15/72	6/18/81
FIRST TRILLING			
American Toad	1 May	4/12/77	5/13/67

Cricket frog calls were heard in Cherokee Marsh during the first half of May 1971 and 1972. But since then the Cricket Frog has only been heard in some other parts of Dane County.

Statewide Summary

This chronology is condensed from 1976 to 1980 reports of WESTERN CHORUS FROG, First Call, summarized in the Fall 1982 Newsletter.

Dates :	Mean	Earliest	Latest
Southern Districts	5 Apr	3/25/76	4/13/80
Central Districts	13 Apr	4/07/76	4/17/80
Northern Districts	16 Apr	4/09/77	4/24/78

For isophenes on the state map of Wisconsin see Section 6.

2. A phenologic study of aquatic invertebrates

Ken Parejoko, Madison, 1987 (Condensed Version)

While we take note of terrestrial phenological events, there are similar biological events occurring in the ponds, lakes and streams around us. As part of the requirements for a Master's degree in Zoology, I undertook a study of eight ponds in Dane County and two in Chippewa County in the spring of 1986. Seven of the ponds near Madison are temporary, which dry up every year, and one permanent. One permanent and one temporary pond were used in Chippewa County.

Ponds were sampled twice a week in Dane County and about once a week in Chippewa County for aquatic invertebrates. Ponds were also monitored for daily maximum and minimum temperatures to calculate accumulated degree days. Weather data at the two sites were related by regression techniques to heat accumulation in the pond.

Ice on northern ponds melted an average of nine days later than southern ponds. Statistically significant differences were also found between melt dates for temporary versus permanent ponds and open-field vs. woodland ponds within Dane County. But when air temperature degree days (DD) to melt were compared, such differences were only significant when comparing permanent vs. temporary ponds. Degree days within the pond were found to differ significantly (slope of DD vs. date) between ponds and also within one pond which was monitored at three sites.

Hopkins' law predicts about a 12.5-day lag in spring phenologies between the Dane County and Chippewa County ponds. To test this, a variety of pond biotic events were compared between sites. These included the first appearance and subsequent disappearance of the four larval states of the pest mosquito *Aades stimulans*, first mosquito pupa, first appearance of the larva of the predatory water beetle *Dytiscus* (sometimes called water tigers) and of the copepods (*Diacyclops bicuspidatus thomasi* and *Acanthocyclops vernalis*, of resting eggs on the water flea *Daphnia pulex* and first appearance of the related *Simocephalus serrulatus*, and of the first chironomid larvae. When all these events are considered, northern ponds lagged southern ponds about 14 days (range 4-28 days), consistent with the prediction of Hopkins' Law. All but two of the events were significantly different ($p<.05$) for northern vs. southern date, but none were significantly different when accumulated degree days were tested. This suggests that accumulated degree days is an important driving factor in the spring reawakening of Wisconsin ponds, in a way which roughly accords with Hopkins' Law. One pond in Dane County was monitored at three sites. One site because of its exposure melted later and warmed more slowly than the other two sites within the same pond. Biological events at that site were about five days behind the other two, which was statistically significant ($p<.10$). This suggests that, as with terrestrial ecosystems, the vernal warming of aquatic systems (even as small as temporary ponds) can be spatially heterogeneous because of local topography, exposure, etc.

b3. Water lily chronology (Oneida County, and Ashland Area)
Dorothy & Alonzo Pond, Minocqua, 1978, and
Mr. & Mrs. James Gilles, Kelly Township, 1978

Dates :	Mean	Earliest	Latest
YELLOW WATER LILY			
Oneida County Wetland	13 Jun	6/06/62	6/19/66
WHITE WATER LILY			
Oneida County Wetland	3 Jul	6/19/72	7/12/69
Ashland Area	27 Jun	6/14/72	7/04/69

6 EXAMPLES OF EVALUATIONS OF PHENOLGOICAL RECORDS

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a: Phenological Degree-day Calendars

a1. Introductory note

Katharina Lettau, Madison; 1992

The term: "Phenological Chronology" is used for listing the year-days of events observed at one station or in one region. Year-days grow annually from 1 to 365 and can readily be converted to monthly dates. Examples are presented in Sections 4 and 5. A "Phenological Degree-Day Calendar" is a listing of events by thermally weighted year-days. The annual sequence of degree-days is obtained by the summation of T-T*, where T is the temperature of the day and T* a threshold temperature. The rationale for the use of degree-days in phenology was briefly outlined in Section 3c4. The important advantage is that degree-day dating, ideally, is valid for years with late as well as early seasons and independent of climate or the geographic coordinates of a place where the event has been observed or can be expected to occur.

Two examples of degree-day calendars have been published in Newsletters by members of the Wisconsin Phenological Society. In 1988, Joseph E. Kaplar, Dubuque, Iowa, reported "full bloom sequences" for a total of 47 tree and shrub species (see 6a2). In 1973, Marlin S. Conrad, Madison, published a selection from his phenological degree-day calendar, which coordinates insect events as well as selected plant events with degree-days (see 6a3).

In Section 3c4, the method of parameter evaluation (in addition to T*, the starting date D* of accumulation) developed by European phenologists was applied. The calendars in 6a2, and 6a3 use T*=40 F and accumulations which start with that year-day at which the temperature excedes T* in early spring. Only positive T -T* are accumulated. This specialized method permits the listing of a great number of phenological events.

a2. Full bloom of 47 tree-species
Joseph Kaplar, Dubuque, Iowa; 1988

Joseph E. Kaplar observed from 1984 to 1988, the dates of full bloom for 47 tree and shrub species at Dubuque, Iowa, located on the west bank of the Mississippi River just across the Wisconsin border. Degree-days (DD), accumulated for a threshold temperature of T* = 40 F were computed for each year. In the following summary, the 1984 to 1988 DD-averages are used to establish a phenological degree-day calendar, ranging from early spring to mid-summer.

Species	DD	Species	DD
Silver maple	68	Bridal wreath	663
Pussy willow	86	Nannyberry	702
American elm	130	Buckeye	702
Red elm	130	Horsechestnut	720
Siberian elm	130	Black cherry	726
Quaking aspen	130	Snowball	730
Forsythia	186	Pagoda dogwood	822
Cottonwood	210	High-bush cranberry	839
Red maple	263	Black locust	879
Boxelder	264	Potentilla	909
Stellate magnolia	264	Weigelea	909
Norway maple	294	Fr. Hugo rose	909
Sugar maple	325	Tuliptree	944
Saucer magnolia	352	Bristly locust	944
Nanking cherry	352	Multiflora rose	1036
Serviceberry	352	Mock orange	1064
Wild plum	423	Washington hawthorne	1064
Flowering currant	423	Catalpa	1257
Apple	466	Dogwood	1358
Redbud	488	Linden (Eur.)	1572
Flowering almond	488	Tree of heaven	1572
Lilac	559	Elderberry	1572
Honeysuckle	576	American chestnut	1783
Mountian ash (Eur.)	648		

a3. Economic insect and plant events
Marlin Conrad, Madison; 1973

The following is a selection from "Phenological Calendar of Economic Insects," by Marlin S. Conrad, Madison. Degree-days (DD) are accumulated with threshold T* of 40 F for the first two lines, but with T* = 50

a3. Economic insect and plant events

Marlin Conrad, Madison; 1973

The following is a selection from "Phenological Calendar of Economic Insects," by Marlin S. Conrad, Madison. Degree-days (DD) are accumulated with threshold T* of 40 F for the first two lines, but with T* = 50 F for the remainder. All DD should be considered tentative because T* values for most insect events are not well known.

INSECT EVENT	DD	PLANT EVENT
Spotted alfalfa aphid hatch	100	Crocuses flowering
Cinara sp.* on red pine hatch	200	Yellow rocket ff
Eastern tent caterpillar "hatch"**	50	Bloodroot flowering
Eastern spruce gall aphid ovipos.	80	Dutchman's breeches ff
Spring cankerworm shotholing	90	Flowering Crab ff
Pine needle scale hatch (1st gen.)	170	Lilac 1/2 in bloom
Corn borer pupation (spring gen.)	180	Mountain ash flowering
Scurfy scale hatch	200	Lilac full flower
Cooley spruce gall aphid hatch	210	Chokecherry full flower
Capsus ater adults ***	390	Peony ff
Eastern tent caterpillar (4th inst.)	400	Honey locust ff
Elm borer adults	485	Vernal alfalfa ff
Elm bark weevils adults	485	Red clover ff
Meadow spittle bug adults	500	Wild rose flowering
Eastern tent caterpillar pupation	500	Sweet clover full bloom
Hawthorn mealy bug crawlers	525	Vetch flowering
European elm scale crawlers	540	White parsnip flower
Apple maggots adults	800	Canadian thistle ff
Pine needle scale hatch (2nd gen.)	1500	Vervain, wild bergamot, soapwort flowering

* Cinara sp. - are large aphids which feed in the new growth portion of the red pine and lay their eggs on the needles in fall.

** "hatch" - for the Eastern tent caterpillar is used because the egg case contains the larvae throughout the winter and emergence would probably be a more suitable term.

*** Capsus ater - a black plant bug which feeds on grasses and is frequently encountered in alfalfa fields.

b: Correlation Studies

b1. Single event correlation as function of distance

Example: Lilac FF in ten Wisconsin counties

Katharina Lettau, Madison; 1975

Faithful reporting by several members of the Society yielded flowering dates of individual lilac bushes for 15 consecutive years, from 1961 to 1975, from 11 counties. Fifteen years of data merit a statistical study that will help to understand the seasonal progress of spring across Wisconsin. A few results are summarized below. Counties are listed in approximate order from south to north.

County	Observer	Date of "First Flower" Average	Earliest	Latest	Coefficient of Correlation
Dane-Madison	Ashman	May 12	5/02/68	5/24/66	1.00
Monroe	Pingle	15	5/07/63	5/25/66	0.95
Fond du Lac	Kosanke	19	5/11/63	5/26/66	0.77
Washington	Cypher	19	5/08/63	5/26/73	0.76
Calumet	Erbach	19	5/09/63	5/26/67	0.64
Burnett	Stone	20	5/08/63	5/30/67	0.54
Winnebago*	DiVall	23	5/16/64	5/30/67	0.35
Marinette	Saeman	23	5/18/64	5/30/67	0.73
Rusk	Anderson	24	5/16/69	6/01/61	0.83
Bayfield	Gilles	29	5/18/64	6/07/67	0.26
Douglas	Wahlquist	30	5/20/64	6/06/70	0.18

*This lilac bush is located in a relatively cold microclimate, only 20 feet from the lake.

The 15-year average of "First Flower" (i.e. the date when at least one floret is open on several clusters) shows the steady migration from south to north within about three weeks as documented in previous studies. The earliest and latest dates indicate the variability of individual years. The range of occurrence of FF during this period exceeds two weeks in all counties, with the extreme of 22 days in Dane County.

The last column of the table shows a statistical parameter which is known as the "coefficient of correlation." These numbers illustrate the relationship between the plus-minus variations of 15 FF-dates for Dane County and the corresponding plus-minus variations for each of the 10 other localities. This ratio serves to answer a question like, "How reliable could one predict the date of lilac flowering for the middle and northern counties in Wisconsin if the average dates (as given in column 1) and the actual date in a given year in Dane County are known?" A correlation coefficient value of +1.0 is the best possible and indicates absolute certainty. Two facts are significant; namely, the numbers are getting smaller away from Dane County, and the rate of decrease increases with distance. A rather abrupt decrease along a line across the middle of the state appears to confirm the existence of a "tension zone," where the correlation between events occurring north and south becomes unreliable. Coefficients of correlation, smaller than ¼ as in the two northern-most counties, suggest that the date of lilac flowering could not be predicted reliably if based on observations in Dane County. I have no explanation for the relatively high correlaton between Dane and Rusk as well as Marinette County.

b2. Multiple event correlation at one site
Example: University Heights area chronology
Katharina Lettau, Madison; 1980

Using the chronology for Madison, University Heights Area (see Section 4b4) differences between FF-dates of paired species are summarized below and supplemented by correlation coefficents between the trendcurves of indicated pairs.

Paired Species	Days of Difference	Correlation Coefficient
Hepatica - Bloodroot	7.7	0.64
Hepatica - Dutchman's Breeches	10.8	0.81
Dutchman's Breeches - Showy Trillium	12.6	0.92
Trillium - Yellow Lady's Slipper	13.6	0.83
Lady's Slipper - Shooting Star	2.1	0.90

The correlation coefficient tells us how reliably the blooming date of a species can be predicted from the blooming date of an earlier species. For example, on the day when hepatica blooms, it can be predicted that bloodroot will bloom 8 days later and Dutchman's breeches 11 days later. Yet, considering the correlation factors of 0.64 and 0.81, the prediction of the blooming day of Dutchman's breeches seems to be more reliable than that of Bloodroot in spite of the longer prediction period. Truly significant statistics, however, should be based on many more years of observation.

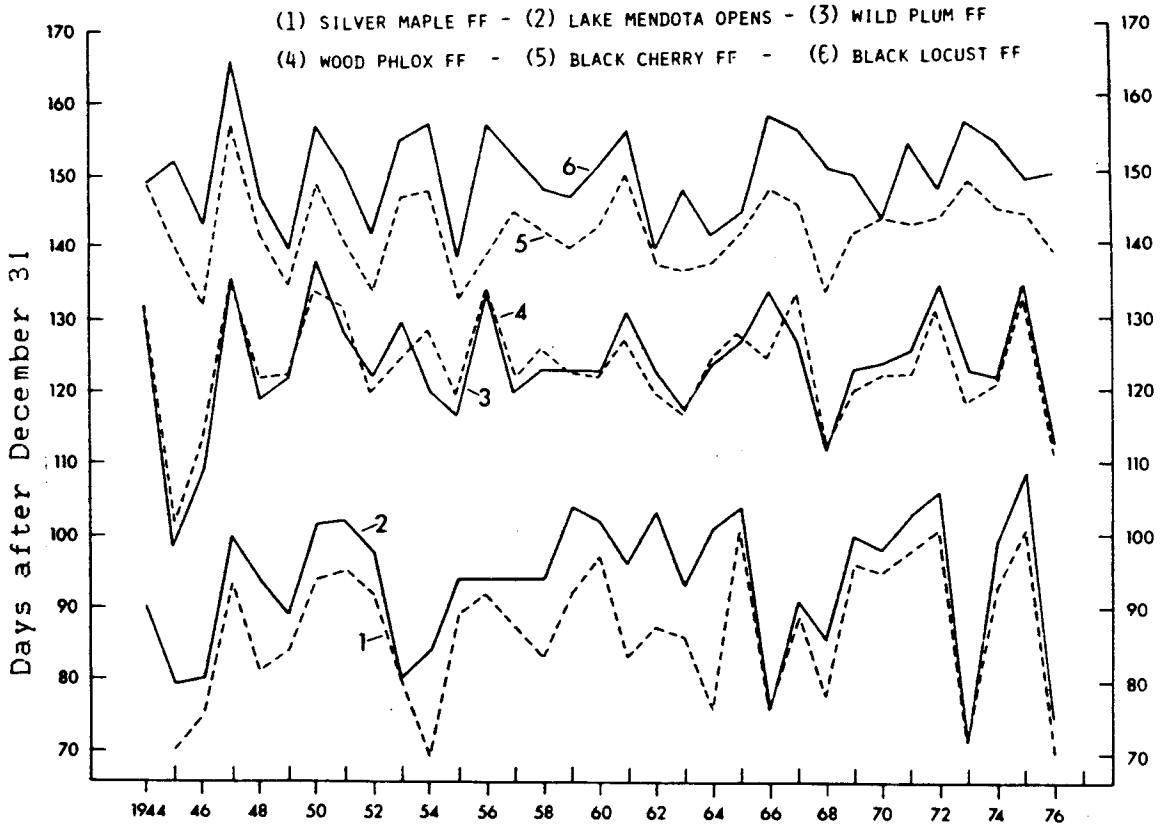
b3. Trendcurve correlations

Example: Lake Mendota opening and plant events

Katharina Lettau, Madison; 1972, 1992

Trendcurves are drawn on graphs with year-days as ordinate and years as abscissa. These curves illustrate how dates of selected phenological events vary from year to year over a period of observations at a station or for a region. The graph below is reproduced from the WPS Manual for Phenological Observers. Dates of five plant events are selected from recordings of James Zimmerman, Madison, for the period 1944 to 1976. Also shown is the trendcurve of Lake Mendota opening dates for the same years.

The first flowering of Silver Maple precedes by about one week the opening of Lake Mendota in early spring of all years. Likewise, the first flowering of Black Cherry precedes that of Black Locust in late spring. Only the trendcurve for Wild Plum is so close to that of Wood Phlox that these two frequently intersect each other. The fluctuations show that only in 1946 and 1950 all six events were late. More often, lateness as well as earlinesss in the first spring month changes to the opposite in the last month of spring. Nevertheless, a chronologic sequence of these events is preserved.


(1) SILVER MAPLE FF - (2) LAKE MENDOTA OPENS - (3) WILD PLUM FF
(4) WOOD PHLOX FF - (5) BLACK CHERRY FF - (6) BLACK LOCUST FF
Days after December 31
170
160
150
140
130
120
110
100
90
80
70
1944 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76

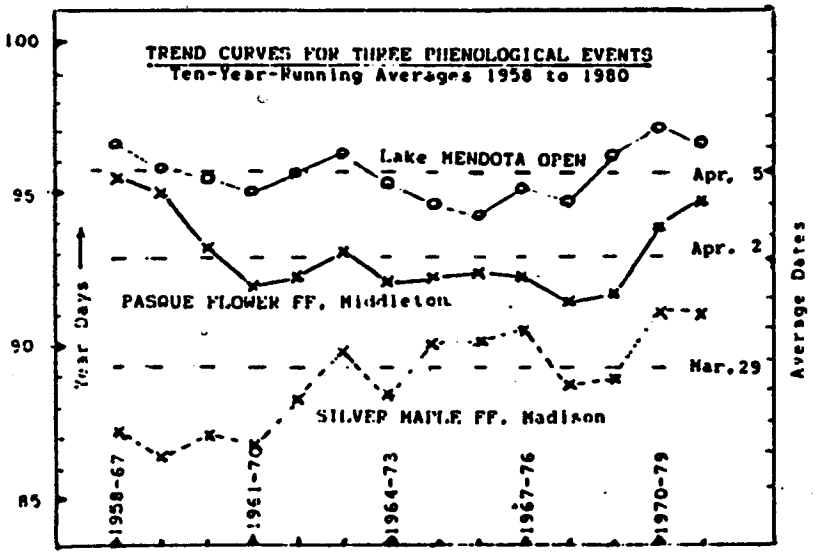
The degree of similarity between fluctuations of two trendcurves is numerically expressed by the ratio known as the correlation coefficient. This ratio is equal to +1.00 for perfect similarity, -1.00 for perfect antisimilarity, and 0.00 for lack of an interrelationship. Differences in similarity are evident when one looks at pairs of trendcurves illustrated above. Correlaton coefficients between opening of Lake Mendota and a succession of plant events occurring from early to late spring are summarized below. Seven events reported in Madison, also pasque flower FF reported in nearby Middleton (see Section 3.4) were selected because of systematically increasing mean dates. With the mean opening date of Lake Mendota as reference point, the events occur from 9 days earlier to 54 days later. The correlation coefficients deviate systematically from +1.00, unity applies only for the trivial case of self-correlation, and change gradually to negative in late spring. This confirms numerically the visual impression gained from the graph of the trendcurves.

Event	Mean Date	Relation to Lake Mendota Opening:	
1944 - 1976	**Year-Day**	**Year Day Difference**	**Correlation Coefficient**
SILVER MAPLE			
First Flower	87	- 9	0.84
PASQUE FLOWER *)			
First Flower	94	- 2	0.83
LAKE MENDOTA			
Opening	96	0	1.00
AMERICAN ELM			
Stamina Full Length	103	7	0.77
COTTONWOOD			
First Pollen	109	13	0.62
WILD PLUM			
First Flower	123	27	0.46
BLACK OAK			
First Pollen	128	32	0.43
BLACK CHERRY			
First Flower	142	46	0.07
BLACK LOCUST			
First Flower	150	54	-0.18

*) 1958-1981

Pasque Flower FF is more poorly correlated with opening of Lake Mendota than Silver Maple FF, in spite of closer mean date. This is partly explained by greater distance, but mainly by different microclimates in the habitat of ground-hugging Pasque Flower and stately Maple trees.

Trendcurves for 14 overlapping ten-year averages from 1958 to 1981 of Silver Maple FF, Pasque Flower FF, and opening of Lake Mendota were published in the WPS Newsletter of 1988 and are reproduced below. The correlation of Lake Mendota opening with Pasque Flower FF is clearly much closer than with Silver Maple FF, mainly because the latter shows a general trend from 1958 to 1981 which was not dominant from 1944 to 1976.



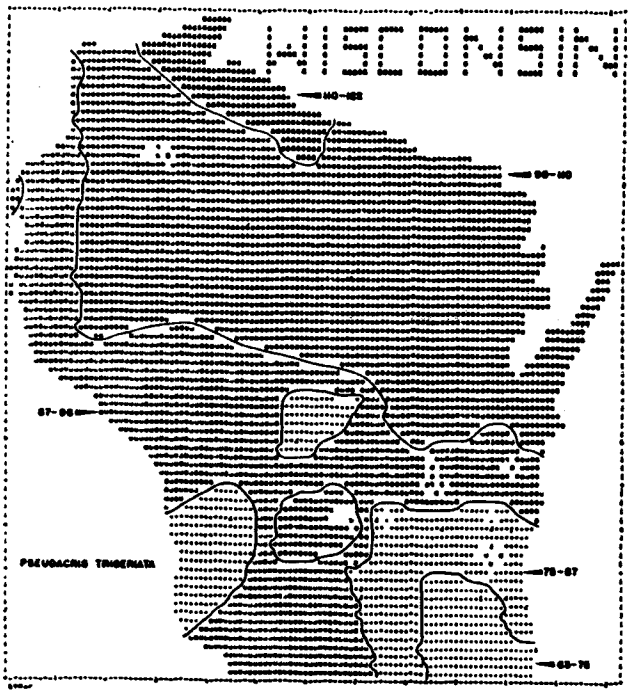
c: Isophene Charts

c1. First calling of Western Chorus frog
Rebecca Anderson, Madison; 1972

In spring 1972, society members were asked to record twelve phenological events for a special project. The same card was sent to more than 800 high school biology teachers in the state. So far, ten percent, 50 society members and 80 teachers, have returned cards with from one to twelve observations and sent records collected by individual students.

The map shown here is made from data sent in. The first calling date of the western chorus frog is shown for regions of the state. Of course, the exact dates change from year to year, but the pattern would be similar over the state. Also the greater the number of observation points and the more evenly they are scattered, the more accurate will be the map.

One might suspect that chorus frogs begin to call when soil and water reach proper temperatures. Notice the warm spots near the Mississippi River and the Necedah Wild Life Refuge, and the cool spot near the Baraboo Hills.



WESTERN CHORUS FROG'S FRIST CALLING DATE
1972 map derived by Rebecca Anderson

Day 63-75	=	March 4 to 16
75-87	=	March 16 to 28
87-98	=	March 28 to April 8
98-110	=	April 8 to 20
110-122	=	April 20 to May 2

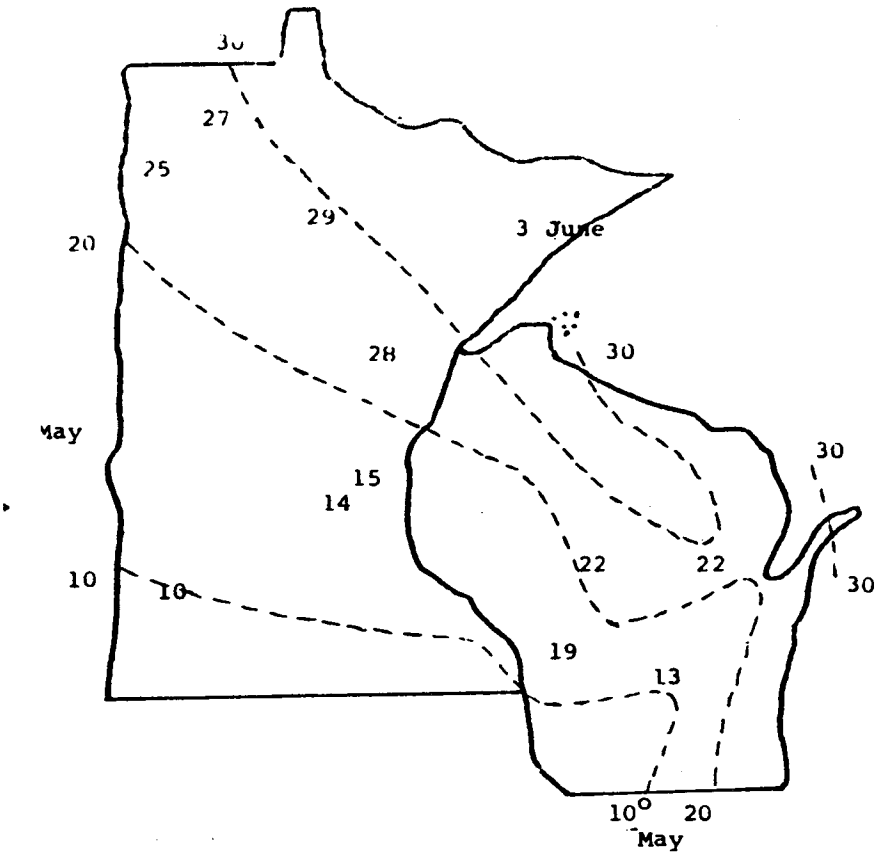
c2. Lilac FF isophenes Wisconsin-Minnesota
Katharina Lettau, Madison; 1974

A "Phenology Studies" group has been organized as a section of the Minnesota State Horticultural Society in November 1976. The purpose of the organization is "to stimulate greater interest in phenology and to work together to establish reliable information so that we may know more about nature's communities of which we are a part."

In due time, it may be worthwhile to coordinate phenological projects with our neighbor state to find out about differences (or similarities) in isophane patterns east and west of the St. Croix and Mississippi rivers.

This tentative spring migration chart is a beginning. Isophanes were constructed for both states using the 1973 dates of "First Flower" of common lilac in connection with Wisconsin observations of the same year from the Minnesota group's diary. The Minnesota group considered 1973 a fairly typical year. In Wisconsin, lilacs came into bloom early in the southern counties. Then, lower than average temperatures during the first three weeks in May slowed down the northward trend. The median flowering date for the whole state in 1973 was one of the latest during 13 years of lilac observations.

The chart confirms the general migration of spring from southwest to northeast, but also shows complications of the isophane pattern in Wisconsin due to the lake effect.



7 DIVERSE STUDIES AND ACTIVITIES IN PHENOLOGY

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a: Phenology and Microclimate

a1. Hepatica flowering on opposite terrain slopes

Jeffrey Klopatek, Milwaukee; 1972

In the spring of 1971, I studied the microclimatic effects on plant phenology in the Fairy Chasm State Scientific Area north of Milwaukee. Three weather stations were established in Fairy Chasm; locations were chosen to provide marked differences between stations. Special instrument shelters (with instruments at 0.5 meters) at each location housed recording hygrothermographs from March 7 through June 21. Earlier, the shelters were equipped with max.-min. thermometers. Station 1 was placed in a level, moderately wooded area of second growth sugar maple, beech, ash, and basswood. Stations 2 and 3 were placed 50 m apart in a ravine less than 100 m from station 1. Station 2, located midway from the base of the 20-m deep ravine on a slope of 31 °, had a direct southerly exposure. Station 3, situated on a 23° northfacing slope directly opposite Station 2, at the same elevation. Both slopes were dominated by white cedar, paper birch, and sugar maple. Balsam poplar grows along the stream which bisects the ravine and white pine grows along the upper edges.

Temperatures at the three stations showed marked differences. Differences between maximum temperatures result from different duration of insolation and the angle at which it is received. Early plant development appears to be most closely related to the amount of heat received by the dormant or growing plant. The unit used in special phenological studies (as in this one) is the degree-hour, i.e., the units of heat per hour (over a certain threshold temperature) available for the plant. In this study a 40° threshold was used.

Events were recorded for 35 different species. Hepatica acutiloba was selected for intense study since it was present in abundance in all three locations (stations). Hepatica FF occurred on the south-facing slope 7 days earlier than on the level area, and 14 days earlier than on the north-facing slope. The three-site average requirement for Hepatica FF was 2285 degree-hours.

Time of peak flowering of Hepatica (based on the largest number of Hepatica in flower at a station at one time) is 16 days apart between the south- and north-facing slopes. The average requirement for peak flowering was 4055 degree-hours. Peak flowering at the stations deviated only 4 percent from the average, while first flowering deviated by 10 percent. This suggests that the peak flowering date may be more reliable for prediction than the date of the first flower. However, the correspondence of degree-hour requirements at all three stations indicates a fairly reliable degree-hour estimate for the prediction of both the date of first flower and of peak flowering of Hepatica in eastern Wisconsin.

Most other species observed were present only at one or two stations. Herbaceous species that occurred at two or three stations closely paralleled Hepatica. The average difference in microclimate between the south-facing and north-facing slope sites, only 50 m apart, causes a delay of flowering by 14 days. Hopkins' Rule is valid for climate differences on the macro-scale, where a delay of 14 days for spring events is expected at 240 miles further northward or 1400 feet in elevation.

Editorial Note: The observed delay of Hepatica FF from two southern to two northern counties is 17 days, for a distance of 2.5 deg latitude which corresponds to 180 miles. This follows from the chronologies for Dane and Western Racine counties, versus Ashland Area and Oneida County; reference: Section 4b.

a2. Robert E. Bailey's frost hollows in Northern Wisconsin
Heinz Lettau, Madison; 1988

Born December 8, 1902, at Hersey, Wisconsin, Robert A. Bailey died May 31, 1988 at Spooner, Wisconsin. A farmer by profession, a forester and environmentalist by inclination, he learned unceasingly by field work and from books, but even more from observing natural plant and animal life around his homestead. Fascinated by the subtlest local and regional differences in plant communities, it was natural for R.A. Bailey to join the Wisconsin Phenological Society as soon as it was founded. Over many years he had experimented with maximum-minimum thermometers to document and interpret the characteristic frost pockets or frost hollows of the region surrounding his farm. He referred to these as "sags" and when Kate Lettau and I visited his home at Sarona in 1971, Mr. Bailey was eagerly guiding us to some representative varieties of sags in his neighborhood. The pitted outwash topography of Washburn County is rich in such dry depressions, some a hundred or more feet in diameter and tens of feet deep. It is well known (see, for example, Curtis' "Vegetation of Wisconsin," or Geiger's "The Climate Near the Ground") that extremely low nocturnal temperatures occur in frost hollows. Even though, we were surprised that in one of Bailey's sags for the clear July day of our visit, the minimum thermometer showed 28 °F.

Bailey's measurements made over many years at the Crotteau Sag yielded average minimum temperatures lower than those at the climate station at Spooner by 12° F in winter, 17° F in spring, 14° F in summer, and 13 °F in fall. Minima below -50 °F occurred here while Spooner reported merely -38 °F in January 1970. Could Crotteau Sag be the "Cold Pole" of Wisconsin? Bailey's measurements at the Seymour Sag with thermometers at the bottom, halfway up-slope, and at the crest, typically showed minima of 25, 29 and 32 °F, respectively, at the end of clear June nights. Of phenological interest is that Bailey found for the bottom of a 60-foot deep frost pocket that leafing was retarded by about three weeks relative to the surrounding uplands. Pine trees he had planted along a fall line showed increasingly stunted growth toward the bottom.

With Mr. Bailey's permission I sent off Len Hall, one of my graduate students, to determine by means of a micrometeorological experiment the "thermal admittance factor" of a typical frost pocket in Washburn County. This factor is responsible for local diversity of diurnal cycles of surface temeprature in general, and extreme minima in particular. A low value implies both: poor efficiency for storing the sun's heat input during the daylight hours as well as weak resistance to nocturanl heat loss causing a strong decline of soil surface temperature trends or cycles generated at the soil surface by alternating shadings and exposures to the sun's beam with the aid of a portable shading device of about two meters in diameter.

Working around local noon of 6 May 1971 under clear sky at the bottom of Bailey's frost pocket, Hall evaluated a thermal admittance factor that ranks near the low limit of the data range for dry porous soil reported elsewhere in the literature. Even a moderate amount of soil moisture would have increased significantly the thermal admittance and inhibited extreme temperature minima. Another factor is gravity flow during the night, causing air to accumulate and intensify the cold at the bottom of any hollow. With these two factors in mind, we can now explain that Robert A. Bailey was able to document that frost pockets run about eight degrees colder than the usually moister and level cranberry bogs which most people in the region believe to be the coldest sites.

Editorial note: Bailey's Frost Hollows are not shown on the Washburn County Map of the Wisconsin Department of Transportation. Using this map, directions for locating the three "sags" mentioned in the article are:

Frost Hollow	N Latitude	Approximate Location
Crotteau Sag	45 ° 48.0'	0.2 mi West of County Rd. B 0.8 mi South of Highway 70
Seymour Sag	45 ° 45.8'	0.6 mi West of County Rd. M 3.4 mi South of Highway 70
Pinetree Sag	45 ° 44.8'	0.5 mi West of County Rd. M <0.1 mi North of County Rd. G

b: Annual Phenology Day – A WPS Experiment

b1. Initiation

Katharina Lettau, Madison; 1971

Plans for designating one day in May as "Phenology Day" were mentioned briefly in the 1970 newsletter. The committee felt that it may be more convenient for the observer to have a choice of two consecutive days for making the observations, namely:

Saturday, May 15, or Sunday, May 16, 1971

We suggested the following:

1. Make observations at one locality only, such as suggested under "Place of Observation" on the reporting sheet.

2. Write down what phenological events you can observe in this area, i.e., report on the state of your immediate environment, either in your own words or using the reporting sheet.

3. Add anything you feel is relevant to describe the state of the nature at this day. Use extra sheets for additional information.

4. It should not take more than an hour of your time.

This is an experimental project, starting this year. If the response is good, "Phenology Day" will become an annual event. The more people participate the more revealing will be the result. Let us hope for a beautiful May day, and please, wherever you are, report on the state of the nature.

b2. Preliminary report – Conclusion

Katharina Lettau, Madison; 1971/1972

We had to take a chance with the weather when we proposed early in spring to make a phenological survey on the weekend of May 15/16. As it turned out we were lucky – both days were just perfect for being outdoors. Here are some quotes from members on the weather.

From Washington County: "May 14-16 proved to be our first warm, even hot, days of the year and spring literally "burst out" all over and there was more progress during these three days than in the past two weeks. It was a beautiful spring day, very hot and dry. Trees and plants are beginning to grow – rather slow to open up so far."

From Lafayette County: "Our area is becoming very dry, dust is beginning to fly. It is a very windy day, maximum temperatures around 85 °."

From Oneida County: "The day was sunny, the average temperature in the 50's, wind was northwest and brisk."

From Ashland County: "The last few warm days have brought out the leaves quite fast. Even the oak trees have tiny leaves, may freeze some night."

From Houghton, Michigan: "The weather on these two days was warm. On the 15th it was in the 70° range with a light half hour rain in the evening. By the evening of the 16th there were many trees, almost all, that showed a two-fold increase in the size of the developing leaves over what they had been on the 14th."

Thirty-three members returned survey sheets from 22 Wisconsin counties, 7 reports came from Houghton, Mich. (thanks to the efforts of Prof. W.T. Brown). The eastern counties are better represented than the western counties. Washington County with 6 reports is covered best.

Observations on 57 different kinds of wildflowers, 35 species of deciduous trees, and 32 kinds of flowering shrubs were recorded. It was also a good day for birdwatching. Fifty-four species were reportedly sighted. In addition to the most common birds of Wisconsin, there were sightings of bluebird, whippoorwill, bobolink, purple martin, ovenbird, killdeer, white swans, and many others not so often seen. Pine siskin, Canada jay, evening grossbeak, and plover were only mentioned in reports from Houghton, Mich.

Twenty-seven different kinds of insects were observed. The mosquitoes had started biting just a few days earlier in the eastern part of the state from where most of the reports came. Black flies and midges were active in the Houghton area, and the "no-see-ums" were bad in Waushara County since the 10th of May. The sunny days brought out bumblebees and honeybees everywhere. Bluebottles, mayflies and June bugs, tiger swallowtails and cabbage butterflies were in the air. Wood ticks became active and large black ants were crawling.

In spring of 1972, May 20 or Sunday, May 21 were designated as observation days. This was almost a week later than in 1971 because members from the northern districts felt that the weekend before the middle of May was too early for their region of the state. The returns were also gratifying.

The Wisconsin Phenological Society emphasizes participation of members and enjoyment of observational activity. In this respect the experiment was a success, as can be concluded from the 1971 Report. Any centralized evaluation of the observations was not intended. If desired, the experiment may be repeated for the enjoyment of a new generation of members.

c: Weekly Phenology Days – A Program at the Wehr Nature Center

c1. First Report

Marlene Nowak, Franklin; 1986

Wehr Nature Center is located at 9701 W. College Avenue, Franklin, WI 53132, and is part of the Milwaukee County Park system.

Since the last snows of winter melted, a small group of volunteer naturalists and I have met every Monday at the Wehr Nature Center in Milwaukee County to observe and record the phenological changes around us. Our emphasis has been on wildflowers and birds, but bugs, butterflies, and tree blossoms likewise captured our attention.

We all grew much in awareness through these five months, even more cognizant of the continuum of seasonal changes surrounding us. More closely than ever before, we watched nature's ever so slow and subtle kaleidoscope of color, form, and beauty – the trilliums and buttercups of spring, summer's bouquet of silphiums and sunflowers, and now, the glory of the goldenrods and gentians and asters of autmun.

Setting an entire morning side each week for our observations has been invaluable. In previous years, conflicting demands kept our records spotty and incomplete. Now it's every Monday, rain or shine. Also, a small group is ideal for our phenological observations. The more eyes, the more we see. But we do find that four to six in a group is best. A larger group tends to break into two units anyway.

We all agree that we've learned a great deal through our participation in Wehr's phenology group – but more than that, we enjoyed every minute of it!

c2. Progress Report

Gloria Zillig, Franklin; 1991

(Original title: "Flower Phenology at the Wehr Nature Center," Wehr Center Newsletter, reprinted with the center's and the author's permission.)

Just inside the door at the Wehr Nature Center is an unusual list posted on the bulletin board. The title of the list is "PHENOLOGY REPORT" with the week's date. This report should interest every nature lover, particularly those who enjoy the many wildflowers found at the nature center. It is a listing of all the wildflowers blooming each week during the spring, summer and fall seasons.

The phenology report is developed weekly by a group of interested volunteers of varied experience that meet each Monday in an informal atmosphere. Armed with their wildflower books, they set out along the nature center trails spotting and identifying all visible wildflowers. The identification is done amid much friendly discussion, and disagreements are ironed out in a spirit of camaraderie.

In the summer, at the height of the season, a multitude of wildflowers can be seen in a variety of colors, almost overwhelming in their richness, beauty and abundance. Throughout the year, over 200 different kinds of flowers can be seen at the nature center.

A plant named on the phenology report often reflects how it was used by Native Americans and the early settlers. An example is the Blue False Indigo found in the prairie. The Word "indigo" means a blue dye, and the word "false" indicates it is not a true indigo plant. Nevertheless, the early settlers used this flower to make a blue dye.

Many wildflowers have unusual names such as Hoary Puccoon, Pussytoes, Pineapple-weed, and Prairie Smoke. The Hoary Puccoon is another dye plant (yellow) which gets its name from its slightly fuzzy leaves and the native American word for the dye plant (puccoon). The Pussytoe gets it name from its flowerhead that suggests the toes of a white kitten. The Pineapple-weed's tiny blossoms smell like its name implies. A plume of smoke seems to wisp off the top of the rose-colored Prairie Smoke as it goes to seed.

Any interested wildflower lover can join the phenology group as it embarks on its search Monday mornings about 8:30 a.m. The PHENOLOGY REPORT is posted weekly and is available to check on the presence of a favorite or unusual wildflower.

d: Phenology in Education

d1. Phenology in the classroom

Marilyn Hanson, Madison; 1984/85

Would young people be enriched by being aware of the phenological events which occur in the natural world? In my biology class at Memorial High School in Madison, students are expected to keep diaries from the end of April to the middle of May. They begin with descriptions ranging from snow on the ground to bare shrubs and brown grass.

They visit four different natural areas during the next four weeks. They write descriptions of all their trips. At the conclusion, they are asked to write a summary diary entry. Read the following entries and you decide if phenology belongs in the classroom.

> "Monday, May 17: I look upon our yard with sorrow and curiosity. I can smell the sweet smell of fragrant flowers in the air. I am sorry to think of the flowers that have come and gone. Some examples are the daffodils, tulips, flowers on the crab trees, and the dandelions.
>
> I wonder what it's like to live such a short life and also do many beings notice them? I know they would be missed if they decided not to bloom one year at all, but yet how many people know their real beauty? I can see that the bushes and the shrubs are full and green as well as new sprouts about one-half inch long on the pine trees. I see that most every tree is filled with leaves that dance in the breeze.
>
> The lilacs now have green leaves and the honeysuckle is in peak bloom. I'm sad to know that these things will go until next year. Yet at the same time, I'm curious to see the new changes that will come with the coming of summmer.
>
> I'm also noticing our pansies that refuse to quit blooming. And our raspberries have budded tiny white flowers along medium-sized green leaves. The blossoms will be out in a day or two but that purple-flowered creeping charlie refuses to go.
>
> And now as I watch, a few tiny fuzzy dandelion seeds float by. I feel like I've watched them live their lives from a small yellow composite flower to a mass of white seeds that float through the air."

Another young person concludes her diary with the following comments.

> "The flowers were so fascinating. I don't think I've ever seen so many flowers in so little time. I never really would have noticed all the small strange flowers that I saw in this course. The flowers come in so many varieties and have their own unique characteristics that I feel that I know them as a friend. Each flower seems to have a different personality.
>
> In these four or five weeks, I have seen and learned more than I have in my life about flowers. Spring is my favorite season, because it seems like everything comes alive again and it is so gorgeous out!"

Young people's lives are enriched and their minds are stretched when they learn about the great diversity and the timing that exists in the natural world.

c2. James Zimmerman's "Phenology Exercise 1972"

Heinz Lettau, Madison; 1992

Among the papers entrusted to us by the late James Zimmerman was a proposal for a University of Wisconsin course entitled, "Botany 271: Phenology Exercise - 1972." Eight pages of text are supplemented by eight pages of graphs, charts, and tables.

James Zimmerman was a charter member of the Wisconsin Phenological Society. He authored a number of articles for our newsletter. A reference to his course was not among these. It goes without saying that a major portion of the material for the "exercise" uses phenological observations made in Wisconsin and results published before 1972 in the newsletters. In fact, much of it is also reproduced in Section 6 of this "Anthology." If a reader should be interested in Zimmerman's proposal, the WPS secretary could supply a xeroxcopy on request.

e: Phenology in Folklore

e1. Folklore of Phenology

Wayne Pauly, Madison; 1976

How do you recognize the arrival of spring? Does spring arrive on March 21st? Or do you perceive spring when maples are flowering, dandelions and pasque flowers are in bloom, and chipmunks are scampering about? The peasants of northern England said that spring hadn't arrived until one could crush a dozen daisies with one footstep. (Maybe there's a connection between early springs and big feet?)

The early farmers often timed their planting with spring foliage development of trees. This led to such memory aids as:

When elm leaves are big as a shilling,
Plant kidney beans, if to plant 'em you're willing.
When elm leaves are big as a penny,
You must plant kidney beans if you mean to have any.

Early English farmers observed that when bramble bloomed in early June, they could expect an early harvest. Certain North American Indians waited for flowering dogwood to bloom before planting corn. These early agriculturalists used plants to show proper planting times instead of the calendars, degree-days and weather reports that we now use.

They also used plants to predict weather (with dubious success). In the spring it was believed that:

If the oak is out before the ash,
'Twill be a summer of wet and splash;
But if the ash is before the oak,
'Twill be a summer of fire and smoke.

There is also the German weather rhyme thus translated:

When the hawthorn bloom too early shows,
We shall have still many snows.

Finally, there is the quaint belief that onions can predict winter weather:

Onion's skin very thin,
Mild winter's coming in;
Onion's skin thick and tough,
Coming winter cold and rough.

I sometimes wonder if we now predict the weather any more accurately than our ancestors.

A few plants obtained their names because of an association with certain seasonal events. "Buffalo-bellow plant" was an Omaha Indian name for lead plant (Amorpha canescens). It blooms simultaneously with the buffalo rutting season. Juneberry (Amelanchier spp.) is commonly referred to as shadbush or serviceberry. Along the Atlantic coast, the flowering of shadbuish designates the time when shad ascend the rivers to spawn. The flowering of serviceberry was a Midwestern signal that roads were passable and circuit riding preachers would soon hold the first services of the year.

Celandine (Chelidonium majus) was called swallow-wort in Europe. Swalllow-wort blooms when swallows arrive in spring, and it continues blooming until the swallows leave in the fall. (Even "celandine" is a corruption of chelidon, Latin for swallow.)

e2. More Folklore

Wayne Pauly, Madison; 1976

"Folklore of phenology" was published in the WPS Newsletter of Spring 1976. In response, readers supplied the following notes which were included in the Fall 1976 newsletter.

The suckers will run when the popple leaves are the size of a squirrel's ear (on the tributaries of the Bad River).

– Tom Ponty, Marengo, Wisconsin

Once the mourning doves start singing they have to be froze out three times before we get spring. Robins have to be snowed on three times before spring. And once frogs start calling, they have to start up again twice more before spring is really here.

Six weeks from hearing the first cicada to frost.

– Ken Lange, Naturalist, Devil's Lake State Park

Bees will now swarm before a near storm.

When bees to distance wing their flight,
Days are warm and skies are bright;
But when their flight ends near their home,
Stormy weather is sure to come; Henry Dunwoody, 1883

On honey production:

A swarm of bees in May is worth a load of hay.
A swarm of bees in June is worth a silver spoon.
A swarm of bees in July isn't worth a fly.

– Floyd Moeller, Madison, Wisconsin

8 OPPORTUNITIES FOR EXTENSIONS OF WISCONSIN PHENOLOGY

a: Unconventional Study Objects

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a: Unconventional Study Objects

a1. Potential of Dragonfly Phenology

William L. Hilsenhoff, Madison; 1969

Many species of aquatic insects may be of phenological importance because they emerge from streams, ponds, or lakes in response to a warming of their environment or completion of their larval development, which is usually a function of warming. Unfortunately, species of mayflies, stoneflies, caddisflies, and midges usually must be captured and returned to the laboratory for identification, and most species in these orders tend to be hard to find and difficult to collect. There is one group, however, in which species are distinctive enough that they can be identified in flight. These are the dragonflies. Dr. Edmund Walker, who published three volumes on the Odonata of Canada and Alaska, was able to identify all of the Canadian species in flight, and many species are so distinctive that a novice can quickly learn to recognize them. A further advantage to their use in phenology is their habit of flying many miles from their breeding site to hunt insects in open areas where they are conspicuous. I frequently observe many species while playing golf. The various species in Wisconsin appear throughout the spring and summer months, the earliest to appear being Anax junius, a large blue-green dragonfly that migrates into Wiscosnin from southern states in late March or April. Other species first appear mostly in May, June, and July.

There are about 130 species of dragonflies in Wisconsin, but about a dozen come to mind as being common and easy to identify. Along streams we find the broad-winged damselflies, Calopteryx aequibile and maculata beginning in late May, the "ruby spot" Hetaerina americana in mid-June, and the large brown dragonfly, Boyeria vinosa in early July. As already mentioned, the first pond species to appear is Anax junius, but Tramea lacerata, another very large species that could also be a migrant, may appear in early May. Its occurrence is followed closely by three abundant and very easily recognized species. Leucorrhinia intacta, Libellula pulchella, and Plathemis lydia. In early June we may expect to see the tiny, amber-winged, Perithemis tenera, followed in mid-June by the large and distinctive Libellula luctuosa, which has large black and white spots at the base of its wings. Finally, in July the large, rufous-brown Pantala flavescens appears on the scene. Hopefully, Wisconsin observers can be encouraged to record the appearance of the above species and others.

a2. Phenology of Mosses

F.J. Hermann, Madison; 1979

Note: The following is an abstract of a contribution by F.J. Hermann, Curator of Bryophytes, University of Wisconsin-Madison. For names of the great variety of mosses, see the original supplement to WPS Newsletter, Spring 1979.

The seasonal development in flowering plants, particularly the dates of flowering and seed-bearing, have long been a fruitful subject for phenological observation and recording. But an equally promising group of plants, the mosses, has been practically overlooked in this field. And one of their advantages is that, whereas in the case of flowering plants the season is limited chiefly to spring, summer and early autumn, in the mosses there are many species that fruit in late fall and winter, so that year-round observations are feasible. Furthermore, much less is known about the seasonal behavior of mosses than is the case with flowering plants.

The point of chief interest in the mosses is, of course, the time of the appearance of the sporophyte, the spore-bearing capsule with (usually) its stalk or "seta." Although many species bear these reproductive bodies as regularly as do the vascular plants, there are a great many also in which sexual reproduction is either so far unknown, or more or less infrequent or at best irregular, and this is what makes phenological observations in the group particularly intriguing.

A somewhat random count of 75 common mosses shows 22 in which the spores mature in spring, 25 in summer, 23 in fall and 7 in winter.

An especially attractive group of spring-fruiting mosses is what is known as the "pygmy mosses." These are rather minute species only a few millimeters high, such as Pleuridium subulatum, of Pleuridium with its golden capsules set like jewels in its tuft of vivid green needle-like leaves is a find not soon forgotten.

Duration of the capsules is another factor meriting recorded observation. In some, such as most of the pygmies, it may be very brief, only a week or two, or even less – in this case even the gametophyte in man species is very short-lived. In others the sporophytes are quite persistent, from May until August in Mnium cuspidatum, and for up to two years in Tetraphis pellucida.

Still another aspect of mosses suitable for phenological study would be the seasonal production of their "flowers," as they were known to early bryologists – the clusters of antheridia and archegonia (surrounded by specialized leaves, the bracts), from which the sporophytes originate. In some species where they terminate a stem in dense clusters, such as in Rhodobryum roseum and Mnium punctatum, they are conspicuous, but in many of the pleurocarpus species, where they are scattered along the stems, they appear as minute buds.

All in all, it may be said that there is something "going on" among the mosses at all seasons, and for this reason they represent an attractive, varied, and largely neglected subject for phenological studies.

a3. Phenology of rare and endangered species

P.B. Whitford, Milwaukee; 1983

Some phenologists may be interested in contributing information beyond the routine and common species which are widely recorded. Little real data exists for many of our less common native species and more data may be of real value in helping to maintain or increase dwindling populations of endangered or threatened species. Fortunately the Wisconsin State Scientific Areas program has preserved a wide selection of different habitat types on over 176 sites around the state. Most of these Scientific Areas have a high number of native species in natural or nearly undisturbed conditions; thus they are ideal sites for observations of natural phenological responses. The Scientific Areas system was established primarily to serve research and educational needs and to protect native species in their natural environments. Some sites are designated specifically to protect threatened or endangered species.

You may already know of a Scientific Area near your home which you could visit frequently enough for phenological study. If not, you may request information from the Scientific Areas Preservation Council, Box 7921, Madison, WI 53707. There are official lists of endangered plant and animal species in the state, and for many of the S.A.'s the Council has printed one-page maps and descriptions, usually with a list of noteworthy species. Some sites have restricted access; in any case, before starting observations in these areas, you should contact the S.A.P.C. to explain your purpose and gain permission for entry.

The DNR Bureau of Endangered Resources is charged with both developing and updating the lists of threatened or endangered species and with their protection. It could be an interesting challenge and of real value if observers could get good phenological data on one or more of these species. The Endangered Species program and the S.A.P.C. staff are both housed in the Endangered Resources Bureau and work closely together. They would like to obtain copies of the data you gather on their sites.

British botanists and plant ecologists have long had a program for study and publication of "ecological life history" data which includes phenological data as well as general information on morphology, reproductive mechanisms and rates, special adaptations, etc. As yet we have no comparable program in the U.S. and, in fact, for most native species we have only the most sketchy and general descriptions of habitat and blooming season as given in common floristic manuals. Without more data, especially about blooming dates, pollination, seed production rates and ripening dates, seed predation, etc., there is little we can do to maintain or increase these species other than locating and preserving their habitats. Phenologists thus could learn a great deal for their own interests and at the same time contribute to general scientific knowledge and to endangered species programs in particular.

b: Urban Home and Garden Phenology

b1. Natural landscape outside the frontdoor of a phenologist's home

David Kapitzke, Little Valley Farm, Richland Center; 1988

"A prophet is without honor in his own country," goes the old saying. And the same could be said of native plants. While wild goldenrods are reviled in the U.S., they are treasured by British gardeners. The glorious purple gayfeathers (liatris) are sold at high prices as cut flowers in the markets in Israel; meanwhile, back home in America they and their habitat, the prairie, are being destroyed. The much venerated oldest tree in Paris is a black locust whose home is the U.S. Perhaps it is time to give honor to our native flora in our own country.

It is not surprising that many phenologists are keen observers of the seasonal cycles of our native flora. They often keep close track of the first flowering in woods, meadows, prairies, and marshes near their home. How much easier, and perhaps more accurate, these observations might be if the same species were growing just outside the front door of the phenologist's home.

For this reason, and many others, growing native plants around homes has become increasingly popular. Because wildflowers grow in a variety of habitats, virtually everyone may have in his or her yard a spot suitable for some native plants. Prairie plants love sunny spots, while woodland species appreciate the shade of deciduous trees along with the cooler soil and higher humidity found there. In the wet soil near a downspout wild iris will thrive. Many wild plants are becoming rare; therefore, conscientious wildflower gardeners get their plants from nurseries rather than removing them from nature. Collecting seeds or saving plants from where they are to be destroyed are other ways of acquiring the plants.

One can imagine a network of wildflower-garden phenologists accumulating data based on observations of native plants in their yards. Perhaps three common, easily grown and long living species could be chosen for such a network. The writer suggests pasqueflower, butterfly weed and bottle gentian.

Pasqueflower (Anemone patens) grows in full sun in exposed windy sites throughout much of Wisconsin. Blossoming in March or early April, it is a joy to see after our long and snowy winter – a natural for keen phenologists! Butterflyweed (Asclepias tuberosa) also likes sun and well-drained sandy soil. Blossoming in mid-summer, it would provide data for a different season. Bottle gentian (Gentiana andrewsii) is well known for coming into bloom in late autumn, so this species would complete the trio whose blossoms appear from March to October.

Perhaps nature centers, often also centers of natural landscaping efforts, would join in the network. Natural landscaping programs exist, for example, at the Wehr Nature Center (Hales Corners, Wis.), the Schlitz Audubon Center (Milwaukee, Wis.), the McKay Center (Madison, Wis.) and the Indian Creek Nature Center (Cedar Rapids, Iowa). The University of Wisconsin-Extension publishes a list of native plant nurseries in Wisconsin.

Editorial note: The chronology in Section 4b4 is an example, showing that a diversity of native plants can grow on a small backyard plot within a city. It should be added that in the same block, Jim Zimmerman's frontyard is famous for the display of flowering native plants.

b2. About James Zimmerman's Madison home and urban area phenology

Heinz Lettau, Madison; 1992

The leading article of this anthology is authored by James Zimmerman, writing enthusiastically about the spiritual rewards of being a phenological observer. Fittingly let us devote the concluding article of this anthology to Jim Zimmerman's achievements in creating with hard labor and loving care a phenological landscape around his urban home, 2114 Van Hise Avenue, Madison. This lot is just about 100 yards to the south and east of our home and garden on 122 Bascom Place. Natural surroundings are described in connection with Kate Lettau's chronology for the University Heights area; see Section 4b4.

The relevant history of this homestead began in 1909 when Catherine Hall bought the lot. In the same year, on the adjacent larger lot, the Bradley House was built which presently is maintained as a historical monument. Miss Hall married James Zimmerman, Sr., an electrical engineer. The family home was built in 1920 and Jim was born in 1925. In Section 2c2 of this anthology, Jim writes about the lasting impressions gained by attending Aldo Leopold's lectures on botany, wildlife, and ecology at the University of Wisconsin: "Aldo Leopold instilled in me a missionary drive to encourage others to involve themselves in the planetary ecosystem, for pleasure and profit."

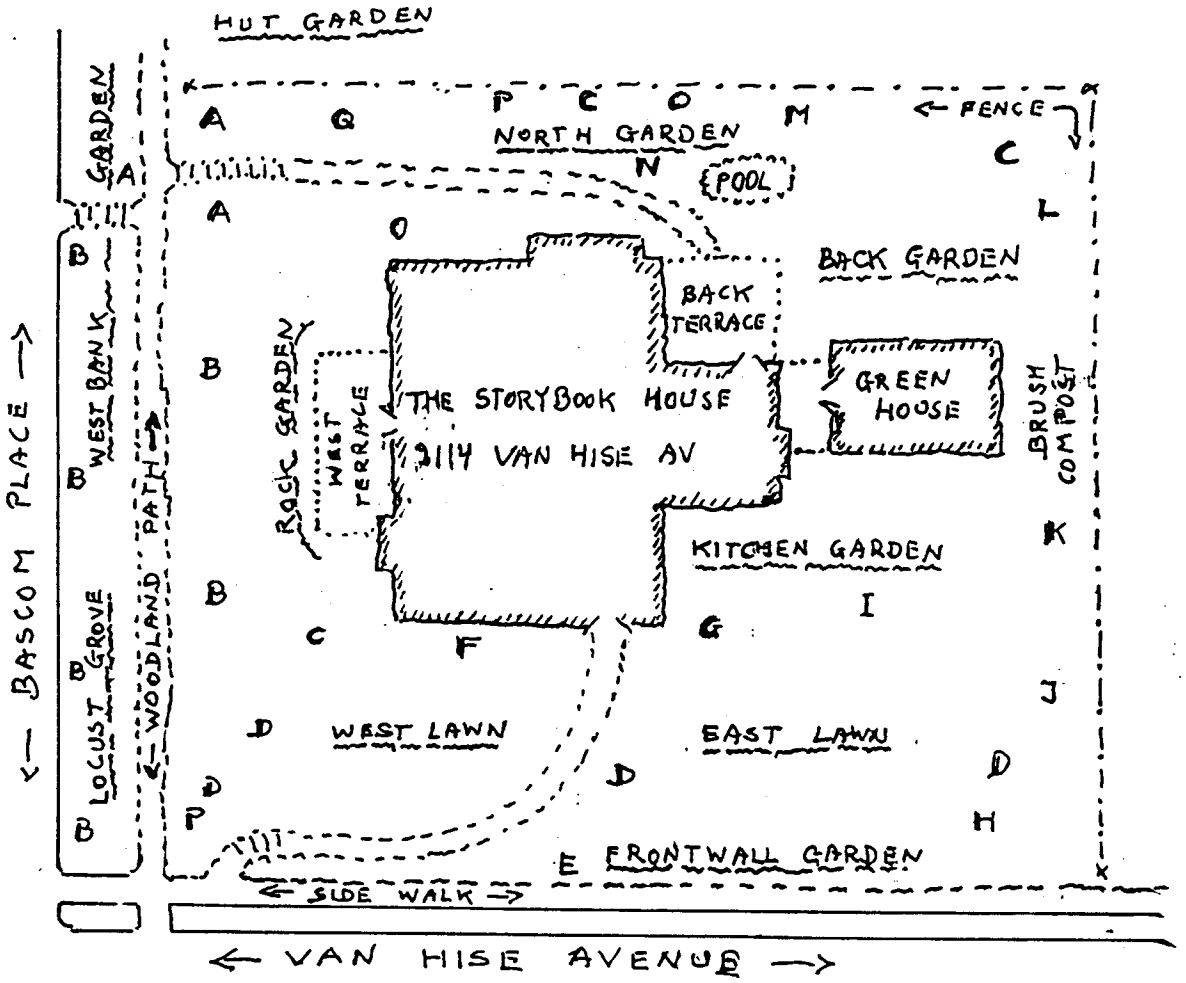
A detailed map of the premises was drafted by Jim in 1977. A redrawn and simplified version is reproduced on the following page. The area of approximately 100 feet by 80 feet is about average for single residence lots of the neighborhood. A lamppost at the SW corner of the lot bears a sign directing visitors to "The Storybook House." Jim listed 17 species of trees and shrubs by individually marked spots on his original map. Plants and wildflower species are growing in natural communities mapped as "gardens" or "lawns" without marked boundaries. One is tempted to say: A phenologist's dream garden come true!

Jim logged, in great detail, multitudes of phenological events, including bird and animal activities. Examples of plant events are 33-year records shown as trendcurves in Section 6b3. Species not growing on his lot were observed by Jim in the neighborhood. For example, silver maple FF at trees two blocks to the east, and cottonwood on the nearby parts of the university campus.

Neighbors loved to stroll along the woodland path or on the sidewalk along Van Hise Avenue. There was always something to watch. In March were the first spring flowers, snow trillium at the westbank garden and snowdrops at the kitchen garden. In April and May, wildflower display peaked on the west and east lawns. In June, the wild roses at the frontwall garden were a delight, and the flowering trees of the black locust grove were spectacular sights, filling the air with fragrance.

Jim Zimmerman succeeded also as "missionary," enticing neighbors to plant wildflowers around their homes. A special friendship developed between Jim and Alfred Flint, a Madison attorney, the original builder and owner of our present home at 122 Bascom Place. Year for year we enjoy in back and front of our house some of the wildflowers originally collected from all over Wisconsin and planted by Alfred Flint. When he died in 1954, his testament included as item #4: "I give James Zimmerman of Van Hise Avenue, Madison, Wis., my cypripedium plants, for his own use, or that of the UW Arboretum, as he may prefer."

Jim transplanted the bunch of yellow lady's slippers into his yard. However, after we had become neighbors and friends 30 years ago, he brought the clump back and replanted it at the spot from where he had removed it 8 years ago. Jim explained that the plants had not been thriving on his lot as well as they had at the Flint house. Gratefully, Kate and I are able to admire now every month of May an increasing number of lady's slippers in bloom. Twenty years ago, five flowers were displayed, and no less than fifteen in 1992.



Jim Zimmerman's Map of Premises – 1977 Version, redrawn and simplified

TREES AND SHRUBS

A: Forsythia
B: Black Locust
C: White Cedar
D: Oaks
E: Wild Rose
F: Juniper
G: Redbud
H: Black Cherry
I: Barberry Hedge
J: Lilacs
K: Peonies
L: Spirea
M: Mulberry
N: Wild Plum
O: Hackberry
P: Elm
Q: Magnolia

PLANTS AND WILDFLOWERS

WESTBANK GARDEN
- Snow Trillium
- Showy Trillium
- Prairie Trillium

ROCK GARDEN
- Bloodroot
- Dutchman's Breeches
- Blue Squill
- Purple Clematis

WEST and EAST LAWNS
- Snowdrops
- Crocus
- Scilla
- Violets
- White Dutch Clover
- Blue Spiderwort
- Sundrops
- Creeping Charlie

FRONTWALL GARDEN
- Sweet Yellow Tulip
- Blue Phlox
- Bittersweet
- Waterleaf

KITCHEN GARDEN
- Snowdrops
- Scilla
- Bloodroot
- Daffodil
- White Anemony
- Blue Camus Lily
- Siberian Iris
- Lily of the Valley

BACK GARDEN
- Trout Lily
- Bellwort
- Twinleaf
- Red Bishop's Hat
- Virginia Bluebell
- Wild Geranium
- Black Raspberry

NORTH and HUT GARDENS
- Winter Aconite
- Hepatica
- Red Peony
- Fuzzy Spirea
- Colombine

ERRATA

Page iv. Under Table of Contents, section 6, should read "6 EXAMPLES OF EVALUATIONS OF PHENOLOGICAL RECORDS."

Page viii. Reference to "108 pages" eight lines from the bottom, should read "105 pages."

Pages 18 & 19. These pages appear reversed in text.

Page 71. Text immediately following the first chart should read "Cricket frog calls were heard in Cherokee Marsh during the first half of May 1971 and 1972." The second sentence should be omitted.

Page 77. Omit section labeled a3. "Economic insect and plant events," to the end of page. This information may be found at the top of page 78.

In this copy only
Pp. 76-105 inverted